A Study of the Resemblance of Parents and Children in General Intelligence

BY
MARION CURRIE OUTHIT, PH.D.

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R. S. WOODWORTH, EDITOR
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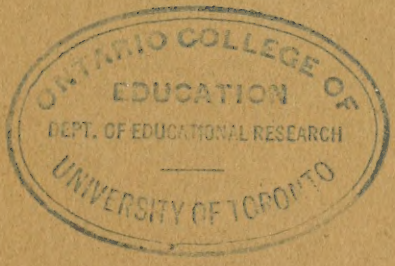

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I. THE PROBLEM

The problem of the inheritance of mental traits has been selected as the subject for this paper. The use of modern objective methods of study, made possible by the recent standardization of tests, should afford more reliable data on parent-child resemblance than that obtained by the questionnaire method of the investigators of the nineteenth century.

To determine the inheritance of mental ability on as wide a scale as possible, the testing of complete families containing four or more children was decided upon. To preserve the integrity of the findings so far as possible, the factors of disease and illiteracy, where they might possibly affect the accuracy of the test results, were eliminated. During 1924–1927, with certain standards as to number, health and literacy thus set up, a group of 51 families were finally selected for study.

The data obtained furnished material for a study of the following: the resemblance between parents, the resemblance between children, and the resemblance between parents and children. The remaining questions also were considered: parent difference and variability of offspring, and the relation of parent education, occupation and age, as well as order of birth and size of family, to the intelligence of offspring.

II. EARLIER WORK

A. On Child Resemblance

The subject of the inheritance of mental traits has been of interest from early times. It remained for Francis Galton, however, to make the first important contribution to the question. Having noticed a tendency for similar characteristics to recur in a family, Galton made a preliminary examination of "the kindred of about four hundred illustrious men of all periods of history" to obtain an idea of the frequency with which certain traits appeared in families. He pushed this inquiry further and then published his findings under the title of "Hereditary Genius." The result of this and other investigations led him to formulate the hypothesis that "natural peculiarities are apparently due to two broadly different causes, the one is Family Likeness, the other is Individual Variation."[1] He expands the idea thus: "Two causes affect family resemblance; the one is Heredity, the other is Circumstance. That which is transmitted is only a sample taken partly through the operation of 'accidents,' out of a store of otherwise unused material, and circumstance must always play a large part in the selection of the sample. Circumstance comprises all the peculiarities of nurture both before and after birth, and every influence that may conduce to make the characteristics of one brother differ from those of another."[2]

In discussing the ability of offspring Galton says: "Because one or both of a child's parents are able, it does not in the least follow as a matter of necessity but only as one of moderately unfavourable odds, that the child will be able also. He inherits an extraordinary mixture of qualities displayed in his grandparents, great grandparents and more remote ancestors, as well as from those of his father and mother. . . . What I profess to prove is this: that if two children are taken, one of whom has a parent exceptionally gifted in a high degree—say as one in four thousand or as one in a million—and the other has not, the former child has an enormously greater chance of turning out to be gifted in a high degree than the other."[3]

He further points out that "the distribution of faculties in a population cannot possibly remain constant, if, on the average, the

[1] Galton, F., *Natural Inheritance*, p. 9.
[2] *Ibid.*, p. 195.
[3] Galton, F., *Hereditary Genius*, p. 57.

children resemble their parents. If they did so, the giants (in any mental or physical particular) would become more gigantic, and the dwarfs more dwarfish, in each generation."[4] What happens is that the offspring tend to regress toward mediocrity. That is, they tend to regress toward the mean of the general population. It is only, Galton says, "when parents are mediocre that their Sons resemble them."[5]

By comparing the offspring of like parents (in stature) with those of unlike parents, he found that there was no greater deviation in the case of one group than in the other, and concluded that the "peculiarities" of the children depended upon the average of the two parents. He called this average the mid-parent value. The statistical treatment of his data on stature disclosed a constant proportion between the mid-filial and the mid-parent deviation and showed the filial deviation from P (the mid-stature of the population) to be, on the average, only two-thirds as wide as the mid-parent deviation.

"The law of Regression," he says, "tells heavily against the full hereditary transmission of any gift. Only a few out of many children would be likely to differ from mediocrity so widely as their Mid-parent, and still fewer would differ as widely as the more exceptional of the two Parents. The more bountifully the Parent is gifted by nature, the more rare will be his good fortune if he begets a son who is as richly endowed as himself, and still more so if he has a son who is endowed yet more largely. But the law is even-handed; it levies an equal succession-tax on the transmission of badness or of goodness. If it discourages the extravagant hopes of a gifted parent that his children inherit all his powers, it no less discountenances extravagant fears that they will inherit all his weakness and disease . . . these statements . . . merely express the fact that the ablest of all the children of a few gifted pairs is not likely to be as gifted as the ablest of all the children of a great many mediocre pairs."[6]

Galton goes on to say that "If the word 'peculiarity' be used to signify the difference between the amount of any faculty possessed by a man, and the average of that possessed by the population at large, then the law of Regression may be described as follows. Each peculiarity in a man is shared by his kinsmen, but in the aver-

[4] *Ibid.*, Prefatory Chap. to Edition of 1882, p. XVII.
[5] Galton, F., *Natural Inheritance,* p. 97.
[6] Galton, F., *Natural Inheritance,* p. 106.

age, in a less degree. It is reduced to a definite fraction of its amount, quite independently of what its amount might be. The fraction differs in different orders of kinship, becoming smaller as they become more remote. When the kinship is so distant that its effects are not worth taking into account, the peculiarity of the man, however remarkable it may have been, is reduced to zero in his kinsmen. This apparent paradox is fundamentally due to the greater frequency of mediocre deviations than of extreme ones, occurring between limits separated by equal widths.''[7]

Following Galton's lead, Pearson measured physical traits of siblings, some of which, such as eye color, could not be influenced by environment. He found a fraternal resemblance of approximately .50 both in traits which could be influenced by environment, and in those which could not. He concluded that ''the environmental influence on physical characters, however great in some cases, is not to the first approximation a great disturbing factor when we consider coefficients of fraternal resemblance in man.''[8] Pearson also studied physical traits of siblings by having trained teachers rate siblings according to his method of ''broad categories.'' He obtained a correlation of about .50, and argued that ''if inheritance and environment are present in psychical characters, they also are present in physical. Physical and psychical characters in man,'' he says, ''are inherited within broad lines in the same manner and with the same intensity.''[9]

Pearson's belief in the influence of heredity on natural ability was strengthened by the outcome of Gordon's study of orphan children. Dr. Gordon obtained a correlation of .53 on 91 pairs of siblings tested by the Stanford Revision of the Binet. When her data were worked over in Galton's laboratory, the correlation table having been made symmetrical, a correlation of .508 $\pm$ .05 was obtained. This corresponded very closely with Pearson's .515 obtained for siblings chosen from different environments and measured by the method of broad categories. In discussing the similarity of the findings Pearson says: ''The conclusion which is emphasized by such different methods from such very different environments is that the relation of intelligence between siblings is fixed by something more innate than environment. That some-

[7] Galton, F., *Natural Inheritance*, p. 194.

[8] Pearson, K., ''On the Laws of Inheritance in Man.'' *Biometrika*, Vol. II, pp. 154–155.

[9] Pearson, K., *Jour. Anthrop. Institute*, Vol. 33, p. 204.

thing more innate, more constant and more universal in its domination can only be the hereditary factor.''[10]

This same conclusion was reached by Elderton who worked over Dr. Gordon's second set of data on 216 pairs of siblings, chiefly orphanage children. Using Dr. Gordon's method of pairing, but ruling out the age factor, Elderton obtained a correlation of .578 ± .03, instead of Gordon's .61.[11] When she took all possible pairs instead of matching each child with the next younger as had been done in the original study, Elderton obtained a correlation of .544 ± .02. The difference between .578 ± .03 and .544 ± .02 is, as Elderton points out, not significant.[12] The latter result is, however, nearer the fraternal resemblance Pearson obtained by the method of broad categories. For brothers at school he found a resemblance of .52; for adult brothers, .54.

Table I summarizes the numerical results of several studies and shows the wide variation of the findings. The difference in the results obtained by these investigators is probably due to their use of different criteria of intelligence, and to the fact that the groups selected for study differed greatly from one another.

TABLE I

SUMMARY OF EARLIER WORK ON CHILD RESEMBLANCE

Investigator	*No. of Pairs of Siblings*	$r \pm P.E._r$
Pearson	2801	.515
Starch	18	.38
Starch	18	.42
Madsen	63	.630 ± .05
Hart	252	.447 ± .034
Hart	147	.459 ± .044
Hart	219	.399 ± .038
Hildreth	325	.274 ± .03
Hildreth	146	.322 ± .04
Hildreth	450	.629 ± .02
Gordon	91	.53
Gordon	216	.61
Willoughby	60	.40
Thorndike	489	.60
Jones	828	.490 ± .018

[10] Pearson, K., ''The Inheritance of Psychical Characters,'' *Biometrika*, Vol. XIV, p. 367.

[11] Gordon, K., *Report of the Children's Department, State Board of Control of California*, 1918–20.

[12] Elderton, E. M., *Biometrika*, Vol. XIV, 1923, pp. 378–408.

B. On Parent-Child Resemblance

Galton's study of the relatives of eminent men drawn from several professions led him to conclude that genius was hereditary and that "the more eminent the man the more numerous ought his eminent relatives to be." He also concluded that more remote ancestry was less influential in the transmission of ability than immediate ancestry. He says, "Though a man has twice as many grandfathers as fathers and probably twice as many grandsons as sons, yet the judges are found more frequently to have eminent fathers than grandfathers, and eminent sons than grandsons."[13]

Pearson, in one of his early studies, found a correlation of .50 between mental traits of fathers and sons. Another early study, made by Schuster and Elderton, in which scholarship was used as the criterion of intelligence, gave a correlation of .31 between father and son.[14] This approximates the results obtained by Willoughby (.35) from a battery of objective tests given to fathers and sons.[15]

Cobb tested children in the fundamental processes of arithmetic and also in speed of copying figures, and compared their ability with that of their parents as shown by the same tests. She found that where one of the parents showed unusual ability in one of these processes the child showed similar ability. The correlation between the child and the parent showing special ability was .60, while between the same child and the parent lacking special ability the correlation was only .01.[16]

The study which most nearly approximates the one about to be described is that of Jones, made in rural sections of New England. Dr. Jones says, "The Army Alpha (Form 5 or 7) was used with the parents and with children above ten years of age. The Stanford Revision of the Binet-Simon Scale was used with the 213 children in the age interval from three and a half to fourteen years."[17] He states, however, that where both tests were given to a child the Army Alpha rating was used for children above twelve and a half years, and the Stanford-Binet for those below that age. The Army Alpha and Stanford-Binet scores were transmuted into sigma scores as follows: "A median mental age was computed at

[13] Galton, F., *Hereditary Genius*, p. 54.
[14] Schuster, E., and Elderton, E. M., *Eugenics Lab. Memoirs*, I.
[15] Willoughby, R. R., *Genetic Psy. Mono.*, Vol. II, No. 4, 1927.
[16] Cobb, M. V., *Jour. Educ. Psy.*, Vol. 8, No. I, 1917, pp. 1–20.
[17] Jones, H. E., *Twenty-Seventh Yearbook Nat. Soc. for Study of Educ.*, 1928, Part I.

each age interval, and a smoothed curve constructed by the formula $\frac{a-2b-c}{4}$. A smoothed curve for the standard deviations was similarly constructed. . . . A mental age score was converted into a sigma score by the formula $x = \frac{X-Md_1}{\sigma 1}$, where x = sigma score, X = M.A. and Md_1 and $\sigma 1$ represent the median and standard deviation M.A. for the individual's chronological age.''[18]

Dr. Jones finds that his material is ''at every point consonant with Pearson's conclusion that 'the physical and psychical characters in man are inherited within broad lines in the same manner and with the same intensity,' although,'' he says, ''it can scarcely be regarded as furnishing conclusive proof.''[19]

[18] *Ibid.*
[19] *Ibid.*

III. THE PRESENT STUDY

A. Procedure

(a) *Families*

1. *Geographical Distribution*

Of the 51 families included in the study, 21 were from cities, 23 from small towns and 7 from rural districts. The majority of families were from New York State. Four other states, the District of Columbia and one Canadian province were represented. The geographical distribution is indicated below.

TABLE II
Geographical Distribution of Families

Locality	*No. of Families*	*Locality*	*No. of Families*
New York City	15	Massachusetts	2
New York State	6	California	2
New Jersey	9	Washington, D. C.	2
Illinois	3	Nova Scotia	12

2. *Type Selected*

The original intention was to restrict the study to families of American-born couples with four or more children of three years and above, and in which neither parents nor children had experienced diseases prone to affect sensory or intellectual ability. The difficulty of finding enough eligible American-born couples soon became apparent. The study was extended, therefore, to include families of parents born in English-speaking countries. An objection to this change lay in the difficulty of comparing the educational standards in the various countries, and in the possibility that unequal opportunities of parents and children might show a parent-child relationship at variance with that found in families where both generations were reared in the same country. However, a comparison of the resemblance of parents and children in the American-born group with that of the group in which parents and children were reared in different countries showed the difference between these groups to be insignificant.

Within this English-speaking group the selection was further limited to families of literate couples, since the test chosen to measure the adults could not be used with illiterate persons. The

study excluded, therefore, non English-speaking parents, illiterates and those suffering from marked psychopathic tendencies, excessive alcoholism, epilepsy, tuberculosis, venereal diseases, and neurological and sensory defects.

3. *Manner Obtained*

The most obvious means of securing information regarding eligible families seemed to be through schools, churches and welfare societies having American families on their lists.

The two public schools recommended proved unfruitful because the principals were willing to assist only to the extent of having their teachers obtain the names of children from families fulfilling the preliminary requirements of birth-place and number of children. But without an introduction from the principal, the cooperation of the parents scarcely could be expected. Nine families were visited, however, and two proved suitable. One agreed to cooperate.

A private school in a small New Jersey town contributed five families. Two parochial schools situated in districts having a large percentage of Irish-American residents also cooperated. These schools provided a room for testing, and arranged to have the preschool children brought there for examination. Detailed reports of the individual examinations were given to the principals in return for their assistance.

After finding that most of the families known to the welfare agencies were unsuitable, the aid of a patriotic society actively interested in educational work was enlisted. Money to be used for a scholarship was given them, and they undertook to interest parents and children in the scheme.

TABLE III

SOURCES THROUGH WHICH FAMILIES WERE OBTAINED

Sources	*No. of Families*
Private Schools	5
Churches and Parochial Schools	10
Welfare Societies	2
Patriotic Societies	7
Psychologists, Students, etc.	21
Miscellaneous	6
Total*	51

* Seven other families were tested, but the results were not included for one or more of the following reasons: partial deafness, alcoholism, fourth child not obtained, previous subjection to test.

Through the influence of psychologists, students and others, 21 families were secured, the parents ranging from professional people to unskilled laborers. The remaining families were obtained through the influence of a church-worker, and by a personal canvass of a farming district. Table III summarizes the sources.

4. *Factors Disqualifying*

Indifference and illiteracy, of one parent or both, accounted for a considerable proportion of the refusals of the parents to cooperate. Though unwilling or unable to participate themselves, they frequently offered, however, to allow their children to act as subjects. Several cases of refusal were due to self-consciousness resulting from a difference in the educational status of the husband and wife.

Many families listed by the schools as suitable in respect to birth-place and number of offspring, proved to have one parent who, though born in America, had been reared under conditions which had prevented him from mastering English well enough to handle the Army Alpha.

The largest single disqualifying factor among the families approached was, however, the age of the youngest child. Over 30 families had one or more children under 3 years of age.

5. *Occupational Status*

Families of different occupational status were secured, but the group does not approximate an "unselected sample" because the greater proportion of the families was from the higher occupational groups, as indicated in Table IV. Consequently, although the range of I.Q. was wide, the mean I.Q. of the group would be expected to be somewhat above the average for the general population.

TABLE IV

Occupational Distribution of Fathers Compared with That of the General Population (1920)

	Professional	*Business, Clerical*	*Skilled, Semi-skilled Labor*	*Agriculture*	*Unskilled Labor*
Percent in U. S.	4.5	13.0	27.0	44.0	12.0
Percent in Group	15.7	23.5	39.2	9.8	11.8

In order to determine whether the group studied was a fair sample, the average I.Q. of children of each occupational class was applied to the parents of each occupational class, on the assumption that the average I.Q. of parents and children would be the same in any group which did not deviate far from the general average. From data supplied by Prof. L. S. Hollingworth based on the findings of G. H. Thomson, Haggerty, Collins and others, the I.Q. to be expected for this parental group was 106 (Table V). The actual I.Q. obtained, using 14 years 10 months as the growth limit, was 107.25. It may be inferred then that the group was a fair sample.

TABLE V

AVERAGE I.Q. AND OCCUPATIONAL STATUS

Occupation	*I.Q.*	*General Population*		*Present Study*	
		%	*% X I.Q.*	*%*	*% X I.Q.*
Professional	115	2.2	253.0	15.7	1805.5
Clerical, etc.	112	4.5	504.0	23.5	2632.0
Skilled Labor	100	37.0	3700.0	27.5	2750.0
Semi-skilled	100	13.4	1340.0	21.6	2160.0
Unskilled	95	42.9	4075.5	11.8	1121.0
Total		100.0	9872.5	100.1	10468.5
Correction			127.5		127.5
Total I.Q. for 100 Individuals			10000.0		10596.0
Average I.Q.			100.0		106.0

(b) *Parents*

1. *Birthplace*

Although the plan was to include only families with parents born in an English-speaking country, two exceptions were made. One father, born in Germany, was brought to the United States in infancy and has lived here ever since. Another father, born in Italy, received part of his education there, but was taught English and spoke it fluently before coming to America. As there was no language difficulty in either case, they were considered satisfactory subjects. Table VI gives the birthplace of the parents.

TABLE VI

BIRTH-PLACE OF PARENTS

	U. S.	*Can.*	*Ire.*	*Eng.*	*Scot.*	*Ger.*	*Italy*
Fathers	25	12	9	2	1	1	1
Mothers	27	13	11	–	–	–	–

2. *Chronological Age*

The chronological age of the parents was from 27 to 67 years. The median age of the fathers was approximately 43, and of the mothers, 41. Table VII shows this distribution.

TABLE VII
DISTRIBUTION OF PARENTS ACCORDING TO AGE

Age	*Fathers*	*Mothers*	*Total*
25–29	1	1	2
30–34	5	9	14
35–39	10	11	21
40–44	15	20	35
45–49	14	7	21
50–54	5	2	7
55–59	.....	.....	.....
60–64	.....	.....	.....
65–69	1	1	2

3. *Education*

The educational status of the parents will be discussed in detail later. It is of interest to note at this point, however, that the attainments ranged from Grade III to postgraduate college work.

4. *Occupation*

It may be recalled (Table IV) that 15.7% of the fathers were engaged in professional work, 23.5% in semi-professional or clerical work, 39.2% in skilled and semi-skilled labor, 9.8% in agriculture and 11.8% in unskilled labor. Table VIII gives the number of fathers engaged in each occupation. The list has been arranged according to the Army Alpha scores made by the fathers. Those occupations making the same score have been bracketed together.

TABLE VIII
OCCUPATIONS OF FATHERS

No.	*Occupation*	*No.*	*Occupation*
1	Carpenter*	1	Policeman
1	Accountant	5	Farmer
2	Lawyer	3	Printer
1	Scientist	2	Waiter
1	Industrial Engineer	1	Shop-keeper
1	Newspaper Man	2	Locomotive Engineer
3	Manufacturer	2	Electrician
1	Civil Engineer	2	Truck Driver
2	Advertising Manager	1	Fireman
1	Teacher	1	Janitor
1	Marble-worker	1	Photographer's Asst.
1	Merchant	2	Taxi Driver
1	Stock-broker	6	Laborer
5	Salesman		

* Degree in engineering.

(c) *Offspring*

1. *Developmental History*

(a) Pregnancies and Plural Births.—The number of pregnancies reported was 299. Twinning occurred in 7 families and a triple birth in 1, raising the number of offspring to 308. The eight cases of plural birth occurred when the mothers were between 30 and 37 years of age. Only one case was the result of a first pregnancy. There were 3 sets of girl twins, 3 sets of boy-girl twins, and 1 set of boy twins. The triplets were boys.

TABLE IX

SERIAL POSITION OF PLURAL BIRTHS

Age of Mother	*30*	*31*	*32*	*33*	*34*	*35*	*36*	*37*
Birth	4	3	.....	12	1	3	.....	5

(b) Losses.—Of the 308 offspring, only 29 were lost—11 males, 16 females, and 2 with sex not known. See Table X.

TABLE X

NUMBER OF CHILDREN LIVING OR LOST

Sex	*No. Living*	*No. Lost*	*Total No.*
Male	136	11	147
Female	143	16	159
Unknown	.....	2	2
Total	279	29	308

The losses were confined to 16 families as follows: 5 spontaneous miscarriages, 3 premature births, 3 stillbirths, 4 lost at birth, 9 lost between 1 and 3 years of age, 4 between 3 and 12 years, and 1 in adolescence. Table XI summarizes this information.

Female offspring were in the majority, and sustained the heavier loss—10.0%. The loss of males was approximately 7.5%. The first-born losses, all males, were about the same as the fourth and fifth-born losses. Table XII gives the known sex and the serial position of the children lost.

TABLE XI

PERIOD AT WHICH CHILDREN WERE LOST

Period	*Male*	*Female*	*Unknown*	*Total*
Pre-natal	1	2	2	5
Birth	5	5	.....	10
Infancy	2	7	.....	9
Childhood	2	2	.....	4
Adolescence	1	.....	.....	1
Total	11	16	2	29

TABLE XII

SEX AND SERIAL POSITION OF CHILDREN LOST

Sex	*Position in Fraternity*											*Total*
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	
Male	6	1	2	1	1*	.....	.....	.....	.....	.....	.....	11
Female	.....	1	.....	3	5	2*	2	1	.....	1	1	16
Unknown	.....	1*	.....	1*	.....	.....	.....	.....	.....	.....	.....	2
Total	6	3	2	5	6	2	2	1	.....	1	1	29

* Miscarriage.

2. *Number Tested and Chronological Age*

Of the 279 living children, 257 were tested. They ranged in number from 4 to 10 in a family. Of the remaining 22 untested (9 boys, 13 girls), 16 were under the 3 year age limit of the Stanford-Binet, 1 was familiar with the test, 1 was away at school, and 4 were living away from home.

TABLE XIII

NUMBER OF CHILDREN TESTED IN EACH FAMILY

No. of Children	*No. of Families*	*No. of Children*	*No. of Families*
4	30	8	1
5	8	9	.....
6	4	10	3
7	5		

The children ranged in age from 3 years, 2 months to 39 years. The median age was 10 years, 4 months, and the Q was 3 years, 7.5 months.

TABLE XIV

DISTRIBUTION OF CHILDREN ACCORDING TO AGE

Chron. Age	*No. of Children*	*Chron. Age*	*No. of Children*
3	12	11	15
4	15	12	12
5	21	13	21
6	17	14	14
7	16	15	9
8	25	16	10
9	16	17–39	34
10	20		

3. *Occupational Status*

When the offspring were divided according to family occupational class, Groups II and IV were equally represented, but Group I contained approximately one and one half times as many children as did Group V. This distribution is in harmony with the family percentages for these groups as shown in Table XV.

TABLE XV

OCCUPATIONAL DISTRIBUTION OF OFFSPRING

%	*Professional*	*Business Clerical*	*Skilled Labor*	*Semi-skilled*	*Unskilled*
	I	*II*	*III*	*IV*	*V*
Families	15.7	23.5	27.4	21.6	11.8
Children	14.8	22.2	30.3	22.5	10.2

(d) *Tests*

Because of the range in age, the group could not be measured on a single test. Two tests whose scores could be compared satisfactorily were, therefore, decided upon. After an examination of the standardized tests available, the Army Alpha was chosen for parents and for children over 12 years of age, and the Stanford-Binet for children under 12 years.

It appeared reasonable to infer that 12 years would be a satisfactory age at which to begin testing on the Army Alpha for the chances were that by 12 even the dullest child in the group would

have been exposed to school influences long enough to gain sufficient skill in the mechanics necessary to handle the test. Furthermore, below 12 years it seemed improbable that there would be children so bright as to be inadequately measured by the Stanford-Binet.

The difficulty of gaining the cooperation of the older members of a family made it advisable to secure their ratings before those of the younger members. In each family the Army Alpha was given the older members as a group except where discrepancies in the educational achievements of the parents and the offspring seemed great enough to cause probable embarrassment to the parents. In these instances the test was given first to the parents and then immediately afterward to the older children. The standardized directions for giving the tests were followed.

(e) *Growth Limit*

The test results have been evaluated in terms of the intelligence quotient. The disadvantage of this method lies in its assumption of a limit beyond which native intelligence ceases to develop, and this limit, in spite of the many studies which have been made, has not yet been agreed upon.

Psychologists found that the average mental age for the United States Army during the World War was less than 14 years, but this is generally conceded to be somewhat lower than would be obtained from an unselected sample of the population. Terman obtained a similar mental age for a group of men who were candidates for positions as policemen and firemen and, judging by their school attainments, this group was obviously below average.[20]

Pintner, as a result of his work, believes 14 the most suitable point to take as the limit of growth of intelligence.[21] Wells agrees with Pintner. He found that adults reaching the "average adult level" of 16 years are "clearly superior to average in educational attainments and general evidence of mental capacity."[22] Ballard also concludes that "it is highly probable that the average age at which growth ceases is considerably below sixteen" for "if after sixteen years the curve is virtually a straight line as it seems to be, we are forced to conclude that sixteen is not the average age at which growth ceases, but the maximum age."[23] He and others

[20] Terman, L. M., *et al.*, *Jour. Applied Psy.*, Vol. I, 1917, pp. 17–29.
[21] Pintner, R., *Intelligence Testing*, 1923.
[22] Wells, F. L., *Mental Tests in Clinical Practice*, 1927.
[23] Ballard, P. B., *Brit. Jour. Psy.*, Vol. 12, 1921, pp. 125–141.

suggest the possibility of mental maturity varying with the individual and with the race.

Based on a re-examination of a large number of feeble-minded persons over a period of ten years, Kuhlmann concludes that "mental age ceases to increase between the ages of fifteen and eighteen, the idiot grade ceasing development about three years earlier than the borderline grade."[24]

From work done with adolescents Thorndike concludes that "the doctrine that the ability to improve one's score in a measure of intelligence necessarily ceases at 14 or 16, then, should be abandoned. Indeed, there seems to be evidence that this ability improves, at least in the case of those who are subject to intellectual education, beyond 18."[25]

While doubt still exists as to the actual number of years mental ability continues to develop, it is known that the rate of growth of the brain is greatest in the early years of childhood and that it decreases considerably by the age of 12. From this time on, the rate becomes appreciably slower and slower so that, in the case of average individuals, it is probably insignificant after the early years of adolescence. Individual variation in the termination of mental growth does not imply necessarily that comparisons based on mental age or intelligence quotients are invalid. Whatever point may be chosen as a limit of growth the intelligence quotient, when it is used as a basis of comparison and not as an absolute measure, is as fair to individuals of low growth capacity as to those of high, since the relative positions of the individuals will always be the same.

Since there has as yet been no unanimous agreement as to the best growth limit to assume in computing the I.Q.'s of adults, in this study three different ages were tried as growth limits in order to see whether the conclusions of the study would be changed. The ages used were arrived at as follows.

The mean Alpha score of the parental group was converted into the equivalent Stanford-Binet mental age[26] (16 years 5 months) which was then used as the limit of growth for the group. On this basis the average intelligence quotient of the offspring was appreciably higher than that of the parents. A reasonable explanation of this difference is that the children who were accustomed to the

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[24] Kuhlmann, F., *Jour. Applied Psy.*, Vol. 5, No. 3, 1921.
[25] Thorndike, E. L., *Jour. Educ. Psy.*, Vol. XIV, No. 9, 1923.
[26] Yerkes, R. M., and Yoakum, C. S., *Army Mental Tests*, 1920.

daily use of pencil and paper were more accurately measured than were those parents whose occupations did not demand the constant exercise of pencil and paper habits. To equalize this difference another method of determining the growth limit was resorted to.

With the Army findings as a guide, various ages were tried as growth limits until one was found which produced the same average intelligence for both parents and children. This age (14 years 10 months) was used as the second growth limit. (This method is based on the assumption that the average intelligence of children is equal to that of their parents.)

To check the results obtained by the two previous methods, calculations were also made with 14 years as the growth limit. This age was chosen because of the consensus of opinion that 14 years would probably be a closer approximation to the average mental age of an unselected sample of the population than would the average mental age found for the Army.

The comparisons were made in terms of I.Q. by means of the Pearson Product-Moment correlations. The father, mother, superior, inferior and mid-parent were compared with the mid-son, mid-daughter and mid-child.

TABLE XVI

COMPARISON OF PARENT-CHILD CORRELATIONS USING DIFFERENT GROWTH LIMITS

Group	*Growth Limits*		
	16 yrs. 5 mos.	*14 yrs. 10 mos.*	*14 yrs.*
Father, Mid-Son	.677 ± .053	.628 ± .059	.609 ± .061
Father, Mid-Daughter	.695 ± .050	.692 ± .050	.673 ± .053
Father, Mid-Child	.744 ± .042	.694 ± .049	.678 ± .051
Mother, Mid-Son	.674 ± .053	.700 ± .049	.710 ± .048
Mother, Mid-Daughter	.756 ± .041	.697 ± .049	.694 ± .050
Mother, Mid-Child	.775 ± .038	.775 ± .038	.774 ± .038
Superior Parent, Mid-Son	.677 ± .053	.674 ± .053	.657 ± .055
Superior Parent, Mid-Daughter	.722 ± .046	.718 ± .047	.689 ± .051
Superior Parent, Mid-Child	.758 ± .040	.744 ± .042	.724 ± .045
Inferior Parent, Mid-Son	.717 ± .047	.707 ± .049	.717 ± .047
Inferior Parent, Mid-Daughter	.782 ± .037	.720 ± .046	.707 ± .048
Inferior Parent, Mid-Child	.811 ± .032	.780 ± .037	.758 ± .040
Mid-Parent, Mid-Son	.713 ± .048	.733 ± .045	.710 ± .048
Mid-Parent, Mid-Daughter	.766 ± .040	.763 ± .040	.718 ± .048
Mid-Parent, Mid-Child	.802 ± .034	.802 ± .033	.775 ± .038

TABLE XVII

ORIGINAL DATA

	F	*M*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*Age of Father at Test*
Age	0	2	26s	27d	30s	32d								36
I.Q.	111	112	98	78	94	102								
Age	0	0	25d	26s	28s	s 30d	32d	34d						39
I.Q.	107	69	96	80	83	97 82	89	89						
Age	0	2	22d	s	24d	d	d	29d	31s	d	33s	35d		40
I.Q.	88	77	106		103			83	89		78	105		
Age	0	6	26d	27d	33s	35s								43
I.Q.	120	99	130	116	122	112								
Age	0	1	32d	m	34s	m	35s	39s	40d	42d	45s			52
I.Q.	109	118	120		99		93	111	116	108	110			
Age	0	8	33s	34d	35d	36d	d	41d	47s					51
I.Q.	106	117	115	126	125	111		98	128					
Age	0	3	31d	32s	35d	36d	d	41d						44
I.Q.	103	96	122	105	119	117		121						
Age	0	1	25d	27d	29s	31s	33d							39
I.Q.	112	128	123	103	95	122	116							
Age	0	6	31d	33s	38d	40d								46
I.Q.	121	129	120	140	131	123								
Age	0	5	s	27d	29d	s	d	34s	40d					48
I.Q.	78	87		102	116			98	112					
Age	0	−1	s	25d	s	d	s	d	d	28s	31s	36s	39s	43
I.Q.	92	75		88						97	81	96	89	
Age	0	−2	24s	26s	28d	31s								39
I.Q.	137	125	112	114	116	111								
Age	0	5	29d	31s	33s	34s	38s							46
I.Q.	137	93	121	109	104	129	107							
Age	0	3	27d	29d	33d	35d								39
I.Q.	130	125	116	112	101	108								
Age	0	2	32d	33d	35d	37s								42
I.Q.	130	130	114	110	114	103								
Age	0	−2	s	d	28s	s	30d	31d	33d					67
I.Q.	131	129			137		136	134	136					
Age	0	2	23s	24d	26d	d	28s							38
I.Q.	95	88	116	107	106		98							

TABLE XVII.—(*Continued*)

	F	*M*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*Age of Father at Test*
Age	0	6	25d	27d	29d	31d	33s	35s	36d	38d	40d	d	43s	48
I.Q.	108	113	126	129	119	121	107	97	103	104	98		104	
Age	0	2	26s	28d	31d	42d								46
I.Q.	117	114	130	125	102	120								
Age	0	0	20d	21d	s 31d									36
I.Q.	86	96	104	109	76 83									
Age	0	8	40s	42s	43s	47d								54
I.Q.	92	97	113	77	110	78								
Age	0	–2	23s	24d	29s	32s	37s							41
I.Q.	99	124	120	109	104	124	98							
Age	0	8	30s	31s	33d	40d								48
I.Q.	114	126	125	96	96	98								
Age	0	10	27s	30s	31d	33s								40
I.Q.	91	89	131	69	118	89								
Age	0	1	34s	37s										42
I.Q.	81	78	81	87 83 80										
Age	0	1	29d	32d	35s	39d								43
I.Q.	118	90	109	92	109	121								
Age	0	3	31s	33d	38s	39s								43
I.Q.	86	71	83	94	98	109								
Age	0	6	26d	28s	31s	33d	36s	38s	40s					44
I.Q.	78	71	65	109	74	88	104	106	104					
Age	0	2	23d	27s	29d	34s	36d							46
I.Q.	89	104	117	114	99	102	93							
Age	0	4	34s	37d	s 41d									46
I.Q.	88	89	114	110	102 102									
Age	0	3	s	19d	20s	22d	24s	26s	27s	28s	30d	31d	33d	39
I.Q.	121	100		97	99	97	80	86	95	103	105	103	107	
Age	0	–5	26s	27s	28s	30d	36s							46
I.Q.	122	134	126	132	117	132	114							
Age	0	–3	26s	29d	33d	35s								40
I.Q.	108	107	107	107	103	93								
Age	0	13	35d	36s	37s	38d	40d	41d	42d					46
I.Q.	111	122	115	108	100	99	101	102	93					

TABLE XVII.—(*Continued*)

	F	*M*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*Age of Father at Test*
Age	0	8	31s	33s	36s	37d								43
I.Q.	86	82	79	85	88	94								
Age	0	1	20s	21s	23s	24d								28
I.Q.	93	103	103	104	82	95								
Age	0	10	31s	32s	34d	35d	36d	41d						47
I.Q.	97	70	82	90	89	92	87	85						
Age	0	1	27d	29d	30s	33s	34d	36d						40
I.Q.	137	130	138	103	124	120	112	102						
Age	0	2	s	s	27s	d	31d	33d	41d					54
I.Q.	120	130			130		135	132	134					
Age	0	7	27s	29d	30d	38d								47
I.Q.	123	113	126	120	115	106								
Age	0	6	s	37d	s	40s	44s	46s	48s					52
I.Q.	116	108		113		128	112	121	122					
Age	0	0	26d	27s	28d	31s								34
I.Q.	136	133	121	112	127	111								
Age	0	7	35d	37d	40d	44s								49
I.Q.	129	120	125	127	106	103								
Age	0	2	32d	34s	37s	39s								47
I.Q.	128	128	115	135	125	125								
Age	0	−7	27d	28d	s	32d								40
I.Q.	89	78	86	84		91								
			81											
Age	0	10	37d	d	39d	41d	44s	45s	48d	49s	50s	51s	52s	58
I.Q.	129	136	132		126	126	135	155	153	145	136	131	101	
Age	0	−1	30d	32d	34d	38d								47
I.Q.	125	124	125	121	133	113								
Age	0	5	24d	26s	27s	29s	30d	32s	34d					39
I.Q.	97	82	95	96	78	64	94	91	98					
Age	0	12	s	32s	33d	34s	36s	37d	39s	41s	43s			48
I.Q.	90	92		116	103	102	100	92	106	104	102			
Age	0	0	26d	29s	31d	34s								37
I.Q.	137	130	134	119	127	119								
Age	0	0	22s	24s	26s	29s								34
I.Q.	109	78	93	87	91	93								

Note: For purposes of further research more extensive data may be obtained from the writer.

The results obtained by using each of the three growth limits are given in Table XVI. A comparison of these results shows that the use of any one of these growth limits rather than another does not produce statistically significant differences in the correlations for the same parent-child comparison. The correlations discussed in the body of the thesis are those obtained with a growth limit of 14 years 10 months (second method).

B. Data

The method of tabulating the original data in Table XVII is as follows. The data on each family are contained in two lines. In the first line is the birth year of the father taken as 0, followed by the age of the father at the time of the birth of the mother and of each child. For example, in the first family, the father was 2 years old when the mother was born, 26 when the first child was born, etc. The father's age at the time of the test is indicated at the end of the first line. Age in every case is given to the nearest year. Sex is indicated by s and d for son and daughter, respectively. A miscarriage is indicated by m.

In the second line the I.Q.'s are recorded. No information is listed under the sons and daughters unavailable for testing.

With the exception of one person whose score is used as a son and also as a father, no individual appears more than once in each mathematical calculation.

In a few cases all members of the family were not tested at the same time. An age distribution obtained from this table will not be identical, therefore, with that given in the body of the report.

C. Results

(a) *Distributions*

The following I.Q. distributions of the parents and children are presented in four ways, namely, general, occupational, individual and average. General distribution covers the I.Q. range of the parents and children, while occupational distribution classes them according to the occupation of the father. Individual and average distribution concern the positions of the individual and the mid-children about the parents.

1. *General Distribution*

(a) Parents.—The I.Q.'s of the parents ranged from 69 to 137, with a median I.Q. of $108.33 \pm .165$. The I.Q.'s of the fathers

ranged from 78 to 137, with a median of 109.28 ± .215. The I.Q.'s of the mothers ranged from 69 to 137, with a median of 107.00 ± .249. The mothers were somewhat more variable than the fathers and had a slightly lower median. Table XVIII gives the I.Q. distributions of the parents.

Plate I shows the distributions to be bi-modal for fathers, for mothers, and when the parents are grouped together. The curve of distribution is cut off abruptly at the upper end because persons of higher intelligence tend to have fewer children than the number set as the minimum in this study.

TABLE XVIII

I.Q. Distribution of Parents

I.Q.	*Fathers*	*Mothers*	*Parents*
60–69	0	1	1
70–79	2	7	9
80–89	8	7	15
90–99	9	7	16
100–109	7	5	12
110–119	7	6	13
120–129	10	11	21
130–139	8	7	15
Total	51	51	102
Median I.Q.	109.28 ± .215	107.00 ± .249	108.33 ± .165*
Mean I.Q.	108.92 ± .172	105.59 ± .199	107.25 ± .132
S.D.	18.2	21.2	19.8

* P.E.

(b) Children.—The I.Q.'s of the 257 children ranged from 64 to 155, with a median I.Q. of 107.83 ± .090. The I.Q.'s of the 127 sons ranged from 64 to 155, with a median of 104.83 ± .134. The I.Q.'s of the 130 daughters ranged from 65 to 153, with a median of 108.83 ± .120. The variability of the sons was slightly greater than that of the daughters, and their median I.Q. was four points lower. The difference between the sexes is insignificant and is due to the fact that one and one half times as many sons as daughters came from the lower occupational groups. Table XIX gives the I.Q. distributions of the children.

The distribution of the sons and daughters taken separately, and as a single group, approximate a normal curve as shown in Plate II. A comparison of Plates I and II shows the children to be less variable than the parents. This is to be expected as the children of these families have the same ancestors.

TABLE XIX

I.Q. Distribution of Children

I.Q.	*Sons*	*Daughters*	*Children*
60–69	2	1	3
70–79	6	2	8
80–89	18	13	31
90–99	23	21	44
100–109	30	30	60
110–119	20	24	44
120–129	16	25	41
130–139	9	13	22
140–149	2	0	2
150–159	1	1	2
Total	127	130	257
Median I.Q.	104.83 ± .134	108.83 ± .120	107.83 ± .090*
Mean I.Q.	105.55 ± .107	109.69 ± .096	107.65 ± .072
S.D.	17.8	16.3	17.2

* P.E.

When the offspring were considered according to age (over and under 12 years), the I.Q. distribution of the older children tested on Alpha ranged from 65 to 155, with a median I.Q. of 115.56 ± .135. The sons ranged from 89 to 155, with a median of 112.78 ± .216. The daughters ranged from 65 to 138, with a median of 118.33 ± .175. Although the median for the sons was lower than for the daughters, the variability of the sexes was about the same. Table XX shows the distribution of the older children.

TABLE XX

I.Q. Distribution of Alpha Children

I.Q.	*Sons*	*Daughters*	*Children*
60–69	0	1	1
70–79	0	0	0
80–89	1	4	5
90–99	9	6	15
100–109	7	12	19
110–119	9	9	18
120–129	5	18	23
130–139	7	11	18
140–149	0	0	0
150–159	1	0	1
Total	39	61	100
Median I.Q.	112.78 ± .216	118.33 ± .175	115.56 ± .135*
Mean I.Q.	113.72 ± .173	114.84 ± .140	114.94 ± .108
S.D.	16.0	16.2	16.1

* P.E.

The Stanford-Binet children ranged from 64 to 153, with a median I.Q. of 103.29 ± .110. The sons ranged from 64 to 145, with a median of 102.18 ± .155. The daughters ranged from 78 to 153, with a median of 104.72 ± .153. In the case of the younger children the sons were more variable than the daughters, the S.D.'s being 17.3 and 15.0, respectively. Table XXI gives the distribution of the younger children.

The I.Q. range of the Alpha and of the Stanford-Binet children was practically the same, being 65 to 155, and 64 to 153, respectively. Within each group the difference between the mean and the median I.Q. was less than one point. This was also true for the general distribution of the children. The difference between the mean I.Q. of the Alpha and the Stanford-Binet children will be discussed under the distribution of children according to occupational class.

TABLE XXI

I.Q. DISTRIBUTION OF STANFORD-BINET CHILDREN

I.Q.	*Sons*	*Daughters*	*Children*
60–69	2	0	2
70–79	6	2	8
80–89	17	9	26
90–99	14	15	29
100–109	23	18	41
110–119	11	15	26
120–129	11	7	18
130–139	2	2	4
140–149	2	0	2
150–159	0	1	1
Total	88	69	157
Median I.Q.	102.18 ± .155	104.72 ± .153	103.29 ± .110*
Mean I.Q.	101.93 ± .124	105.14 ± .122	103.34 ± .088
S.D.	17.3	15.0	16.4

* P.E.

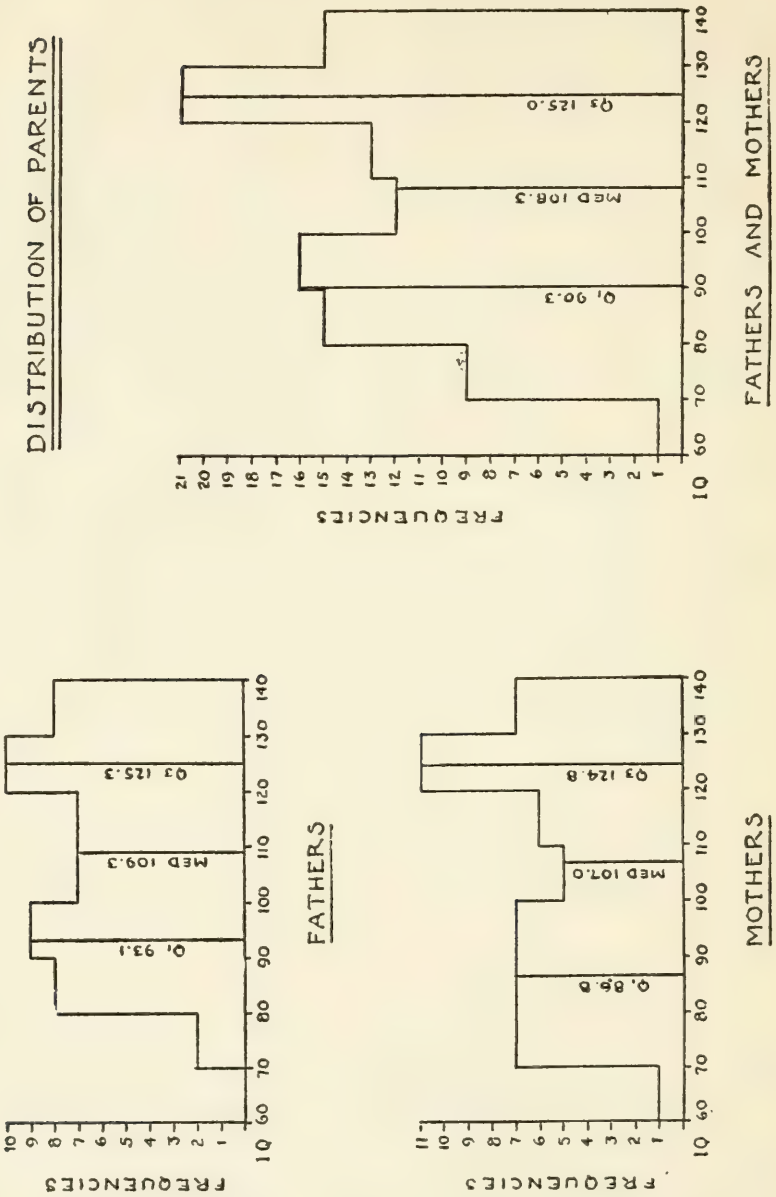
2. *Occupational Distribution*

(a) Parents.—When the parents were grouped according to their occupational classes, there was no significant difference in the I.Q. of the fathers and mothers except in the semi-skilled labor group where the average I.Q. of the fathers was appreciably higher than that of the mothers.

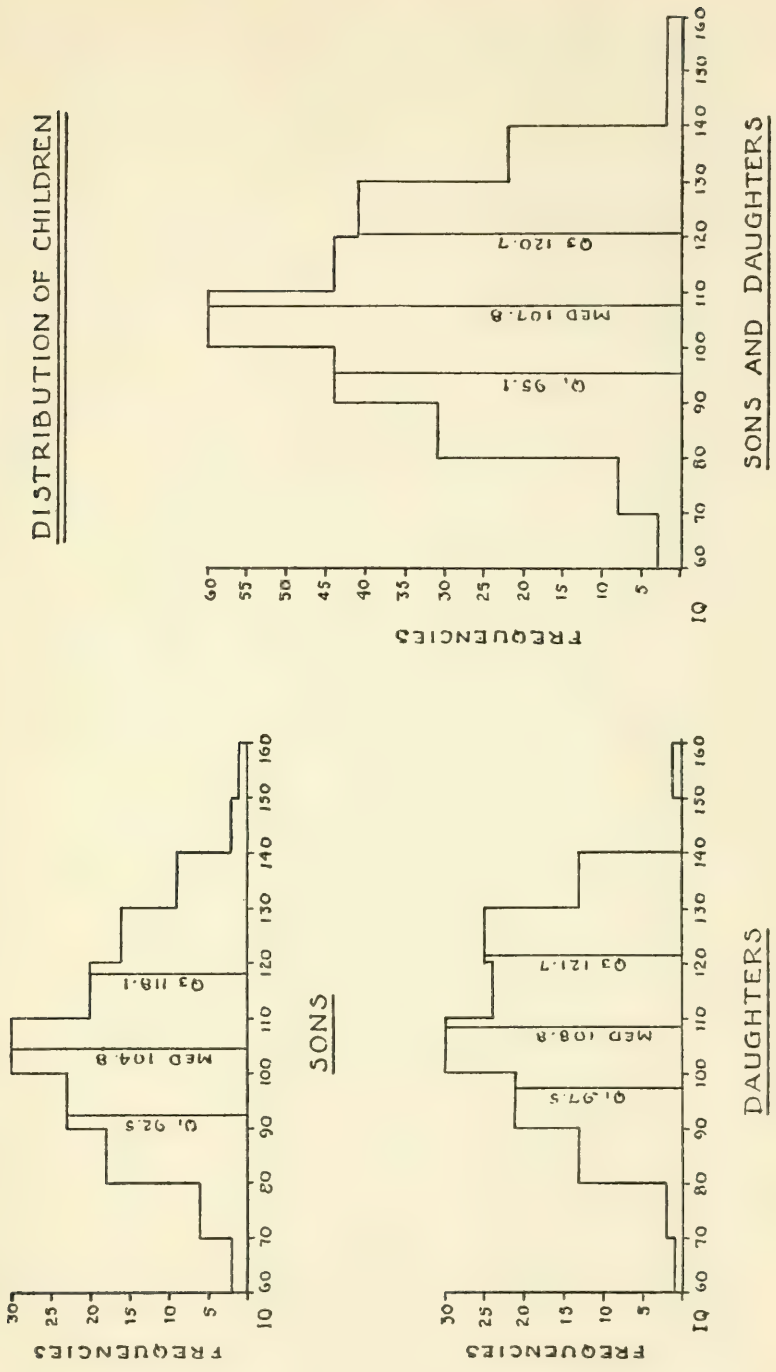
(b) Children.—When the children were divided according to occupational class (Table XV) it was seen that Classes II and IV

PLATE I.

DISTRIBUTION OF PARENTS



• PLATE II •


DISTRIBUTION OF CHILDREN
SONS AND DAUGHTERS
SONS
DAUGHTERS
FREQUENCIES
IQ
Q1 95.1
MED 107.8
Q3 120.7
Q1 92.5
MED 104.8
Q3 118.1
Q1 97.5
MED 108.8
Q3 121.7

were equally represented but that Class I contained nearly one and one half times as many children as did Class V. On the assumption that there is a positive correlation between the occupational status of the father and the I.Q. of the child, this unequal distribution would account for the average I.Q. of the children (107.65) being above that of the general population.

When the children were distributed according to occupational class, their I.Q. averages showed a steady decrease for the first three occupational groups (Table XXII). The average of the fifth group, however, was slightly higher than that of the fourth.

When the children were divided according to sex, the average I.Q. of the sons decreased as expected from the highest to the lowest group, while that of the daughters decreased steadily until the lowest group was reached, when it rose sharply. This explains the rise noted above in the total average I.Q. of all children in the lowest group. It is probable that some of these daughters are the offspring of fathers who, through lack of educational opportunities in childhood, were forced to remain in occupations below the level of their ability.

(c) Parents and Children.—A comparison of the average I.Q. of the children in each occupational class with that of the parents showed a close correspondence between them except in the unskilled labor group where the children were somewhat higher than their parents.

When the parents and children were considered according to sex, it was found that in the semi-skilled labor group the mothers were inferior to the fathers and the children, while in the unskilled group

TABLE XXII

I.Q. Distribution of Parents and Children According to Occupational Class

	Professional	*Business Clerical*	*Skilled Labor*	*Semi-skilled*	*Unskilled*
	I	*II*	*III*	*IV*	*V*
Fathers	129.88	121.00	105.79	97.36	85.67
Mothers	125.63	119.33	104.14	83.73	88.33
Sons	125.24	114.86	102.81	95.77	90.54
Daughters	125.05	118.09	105.37	93.43	102.31
Parents	127.76	120.16	104.97	90.55	87.05
Children	125.13	116.72	104.28	94.84	96.42

both parents were inferior to the children and especially to the daughters. The I.Q. distribution according to occupational class (Table XXII) is illustrated in Plate III.

When the offspring were divided according to age (over and under 12), the average I.Q. of the Alpha and the Stanford-Binet sons showed a steady decrease throughout all five occupational groups, but the average I.Q. of the Alpha and the Stanford-Binet daughters rose in the fifth group. The daughters, and more particularly the Alpha daughters were, therefore, responsible for the unexpected rise in the average I.Q. of children of the unskilled labor group noted in Table XXII.

TABLE XXIII

I.Q. Distribution of Alpha and Stanford-Binet Children According to Occupational Class

	Professional	*Business Clerical*	*Skilled Labor*	*Semi-skilled*	*Unskilled*
	I	*II*	*III*	*IV*	*V*
Alpha Sons	130.57	117.25	107.36	108.00	98.00
Alpha Daughters	126.50	122.73	112.88	91.00	106.67
St.B. Sons	121.50	113.88	100.04	91.54	89.92
St.B. Daughters	122.14	114.00	100.04	95.00	98.57
Alpha Children	127.86	120.83	110.39	99.50	105.43
St.B. Children	121.77	113.94	100.04	92.75	93.11

When the older and younger children were compared according to mean I.Q., there was a difference of 10.8 in favor of the older or Alpha children. The question arose as to whether this apparent superiority of the older children was due to a difference in the accuracy of the two measuring instruments used, a difference in the mental ability of the older and younger children, or to a difference in the proportion of the Alpha and Stanford-Binet children from the upper and lower occupational groups.

A comparison of the distributions of the older and younger children according to occupational class (Table XXIV) showed that while the Stanford-Binet children were normally distributed throughout the five groups, the number of Alpha children was too high in the highest group and too low in the lowest group. In other words, 44% of the Alpha children came from the two higher occupational groups as compared with 33% of the Stanford-Binet

children, and only 25% of the Alpha children came from the two lower occupational groups as compared with 37% of the Stanford-Binet children. It would appear then that this over-representation of the higher occupational classes among the Alpha children would account, in the main, for the 10.8 difference in I.Q. between the older and the younger children.

TABLE XXIV

DISTRIBUTION OF ALPHA AND STANFORD-BINET CHILDREN ACCORDING TO OCCUPATIONAL CLASS

%	*Professional*	*Business Clerical*	*Skilled Labor*	*Semi-skilled*	*Unskilled*
	I	II	III	IV	V
Alpha Children	21	23	31	18	7
St.B. Children	11	22	30	25	12

3. *Family Distribution*

The I.Q. distributions of the parents and children having been considered in a general way and also according to occupational groups, they were considered next from the point of view of the individual in relation to his family. Plates IV, V and VI show this distribution.

In Plate IV the mid-parents are arranged in ascending order according to I.Q. and the families grouped about them. The mid-parents are represented by a dotted line, the fathers by black squares, the mothers by black circles, the sons by white squares and the daughters by dotted white circles. The parental mean (107.25) is indicated by a broken horizontal line, while the accepted limits of average intelligence are indicated by two solid horizontal lines.

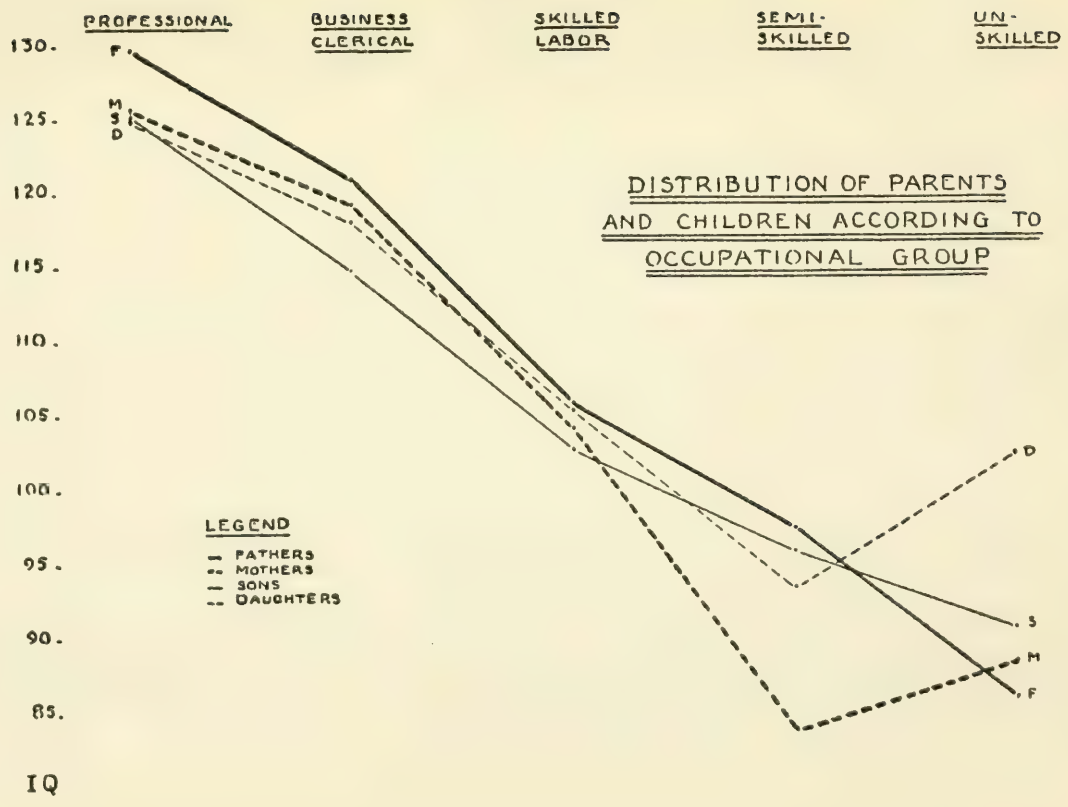
Analysis of Plate IV shows that in 18 families the parents were not of the same I.Q. class (inferior, average, superior). In 39 families the children were not of the same I.Q. class. Table XXV shows the I.Q. class of the remaining families.

TABLE XXV

DISTRIBUTION OF INFERIOR, AVERAGE AND SUPERIOR PARENTS AND CHILDREN ACCORDING TO FAMILY

	No. of Families		*No. of Families*
Both Parents Inferior	8	All Children Inferior	1
" " Average	5	" " Average	1
" " Superior	20	" " Superior	10

• PLATE III •


PROFESSIONAL
BUSINESS CLERICAL
SKILLED LABOR
SEMI-SKILLED
UN-SKILLED
130.
125.
120.
115.
110.
105.
100.
95.
90.
85.
IQ
F
M
S
D
DISTRIBUTION OF PARENTS AND CHILDREN ACCORDING TO OCCUPATIONAL GROUP
LEGEND
FATHERS
MOTHERS
SONS
DAUGHTERS

In 30 families the father had a higher I.Q. than the mother. In 7 families all the children were higher than either parent, while in 6 families all the children were lower than either parent. This distribution is summarized in Table XXVI.

TABLE XXVI

DISTRIBUTION OF PARENTS AND CHILDREN WITHIN THE FAMILY

	No. of Families
Inferior I.Q.	
Fathers higher than Mothers	6
Mothers higher than Fathers	2
Average I.Q.	
Fathers higher than Mothers	8
Mothers higher than Fathers	5
Superior I.Q.	
Fathers higher than Mothers	16
Mothers higher than Fathers	12
All Children higher than either Parent	7
All Children lower than either Parent	6

The distribution of the sons and daughters above their parents was considered next, in terms of percentage. Table XXVII shows that, although there were more children above the mother than the father, sex was not a factor in this unequal distribution.

TABLE XXVII

PERCENTAGE OF CHILDREN ABOVE PARENTS ACCORDING TO SEX

	Above Father	*Above Mother*	*Above Superior*	*Above Inferior*	*Above Mid-Parent*
Sons	46	58	36	68	51
Daughters	45	58	36	68	55
Children	46	58	36	68	53

The distribution of the inferior, average and superior children above their parents was considered next. It was stated above that there were more children above the mother than the father and that sex did not explain this difference. Table XXVIII shows that the high percentage of inferior children above the mother would account for this unequal distribution. Plate V shows the distribution of the three groups of children above their parents.

TABLE XXVIII

PERCENTAGE OF CHILDREN ABOVE PARENTS ACCORDING TO I.Q.

% *Children*	*Above Father*	*Above Mother*	*Above Superior*	*Above Inferior*	*Above Mid-P*
Superior	64	58	50	77	63
Average	38	55	33	61	44
Inferior	14	69	16	69	45

The distributions given in the preceding tables and plates concerning the individual parents and children are summarized under the mid-parent mid-child distributions.

In Plate VI the 51 families again were distributed as in Plate IV with one difference—the children were represented as mid-son, mid-daughter and mid-child.

Table XXIX shows the number of inferior, average and superior mid-children produced by the inferior, average and superior mid-parents. The mid-children of the inferior and superior mid-parents show, in a general way, the regression of the offspring toward the average. Plate VI illustrates this. The apparent tendency of the superior mid-children to show less regression than the inferior mid-children may be due to a truer rating of their parents who, through education and occupation, developed pencil and paper habits adequate to express their native ability.

TABLE XXIX

DISTRIBUTION OF INFERIOR, AVERAGE AND SUPERIOR MID-CHILDREN ABOUT THEIR MID-PARENTS

Mid-Parents	*No.*	*No. Inferior Mid-Children*	*No. Average Mid-Children*	*No. Superior Mid-Children*
Inferior	12	6	6	0
Average	12	0	10	2
Superior	27	0	7	20

The percentage of mid-children above the parents is shown in Table XXX. There was no appreciable difference between the sexes in regard to their respective positions above the parents, with one exception. There were 11% more mid-sons than mid-daughters above the superior parent.

The percentage of mid-children above the parents according to I.Q. group is shown in Table XXXI. The inferior individual chil-

TABLE XXX

PERCENTAGE OF MID-CHILDREN ABOVE PARENTS ACCORDING TO SEX

% Children	Above Father	Above Mother	Above Superior	Above Inferior	Above Mid-Parent
Mid-Sons	48	60	40	69	56
Mid-Daughters	45	55	29	71	59
Mid-Children	49	53	33	69	51

dren are often superior to their parents (Table XXVIII) while the inferior mid-children show this tendency to an even greater degree. The superior mid-children, on the other hand, are less superior to their parents than are the same children taken individually. To facilitate comparison the data in Table XXVIII are included in the following table.

TABLE XXXI

PERCENTAGE OF INDIVIDUAL AND MID-CHILDREN ABOVE PARENTS ACCORDING TO I.Q.

% Children	Above Father	Above Mother	Above Superior	Above Inferior	Above Mid-Parent
Superior					
Individual	64	58	50	77	63
Mid	52	43	33	62	52
Average					
Individual	38	55	33	61	44
Mid	60	50	40	70	50
Inferior					
Individual	14	69	16	69	45
Mid	40	80	30	90	70

(b) *Correlations*

The following correlations to determine the relation between parents and children are divided into three parts, namely, parent, child and parent-child. The parent-child correlations are subdivided into two parts—those dealing with parents and single children, and those concerning parents and mid-children. Under the parents and single children, the father, mother, superior parent, inferior parent and mid-parent are correlated with the first four children. Under parents and mid-children, the father, mother, superior parent, inferior parent and mid-parent are correlated with the mid-son, the mid-daughter and the mid-child.

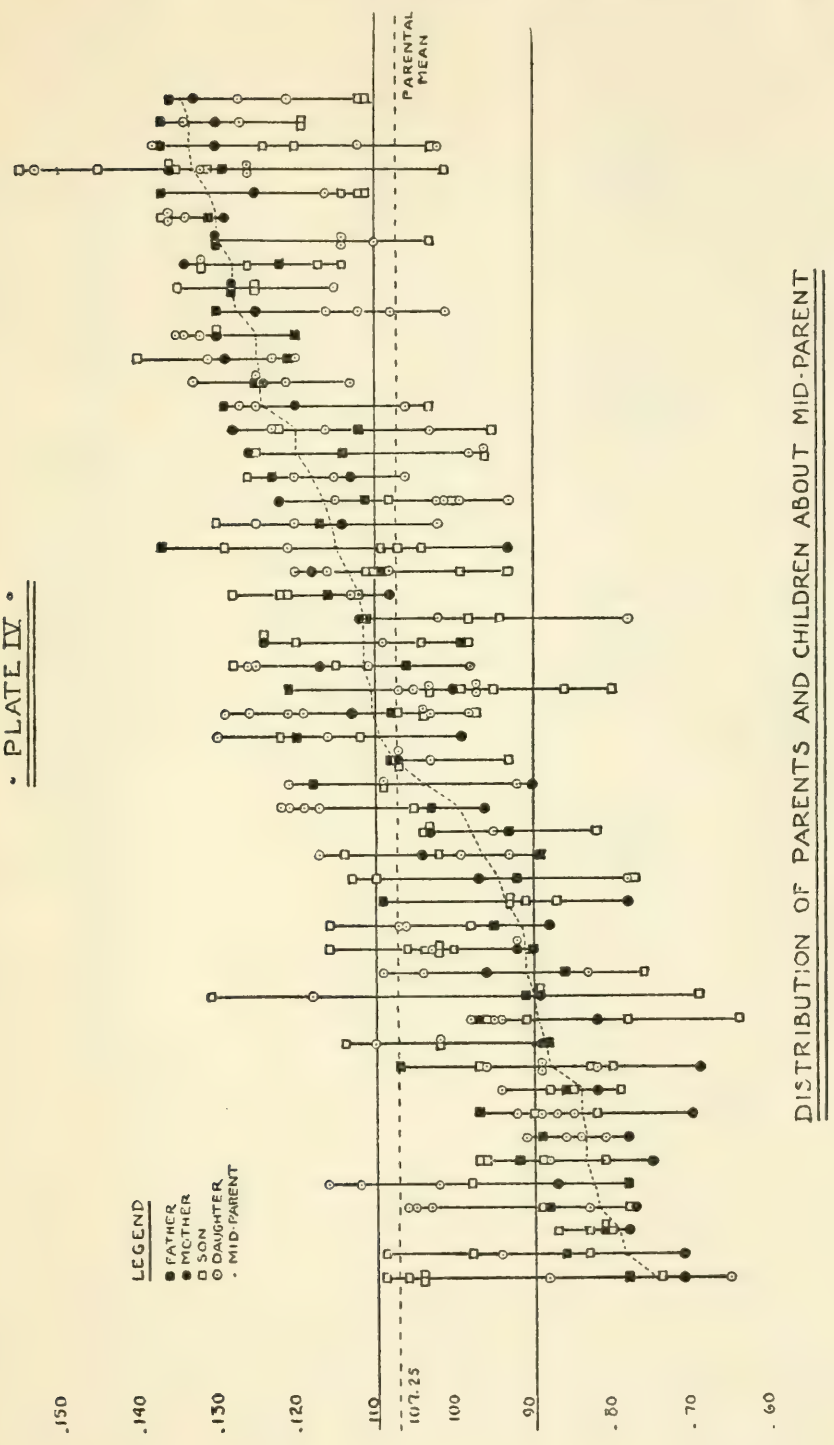
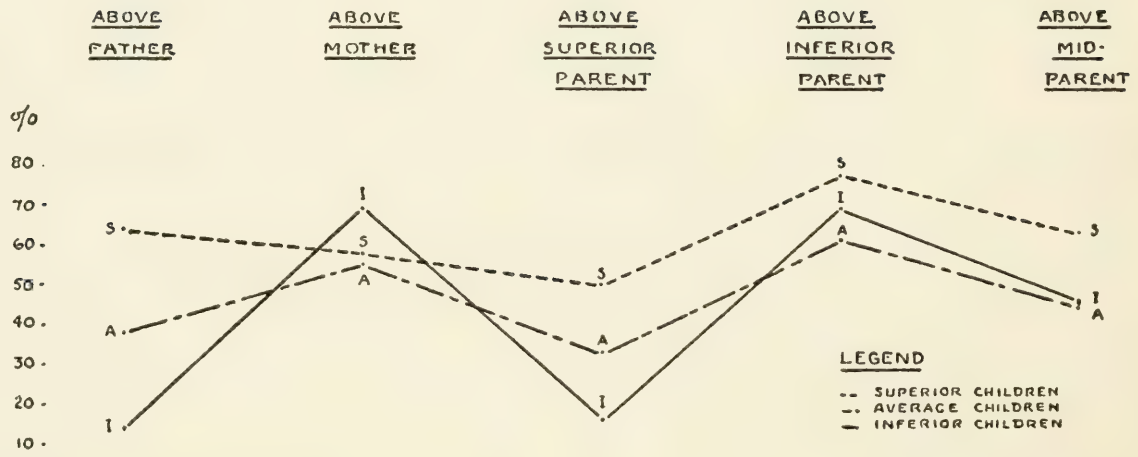


PLATE IV

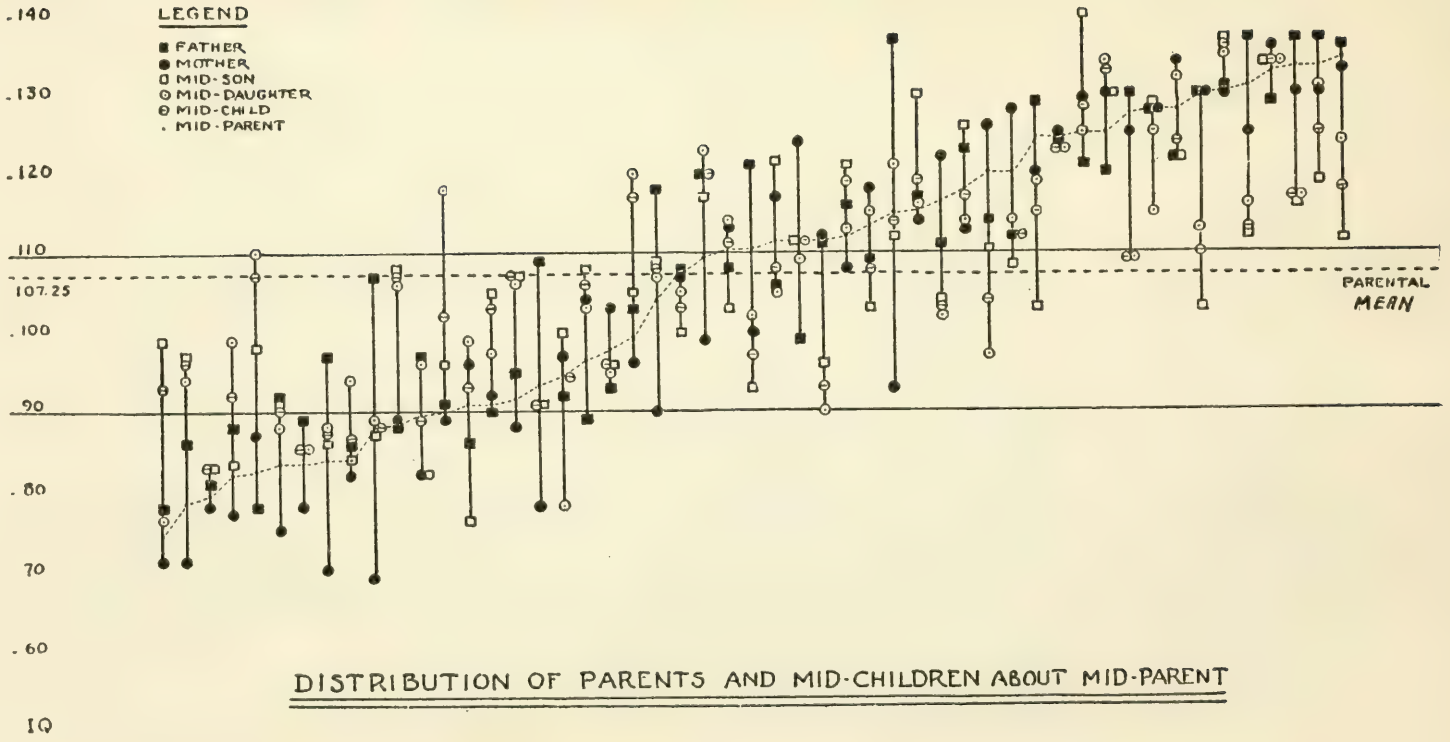
DISTRIBUTION OF PARENTS AND CHILDREN ABOUT MID-PARENT

PLATE V



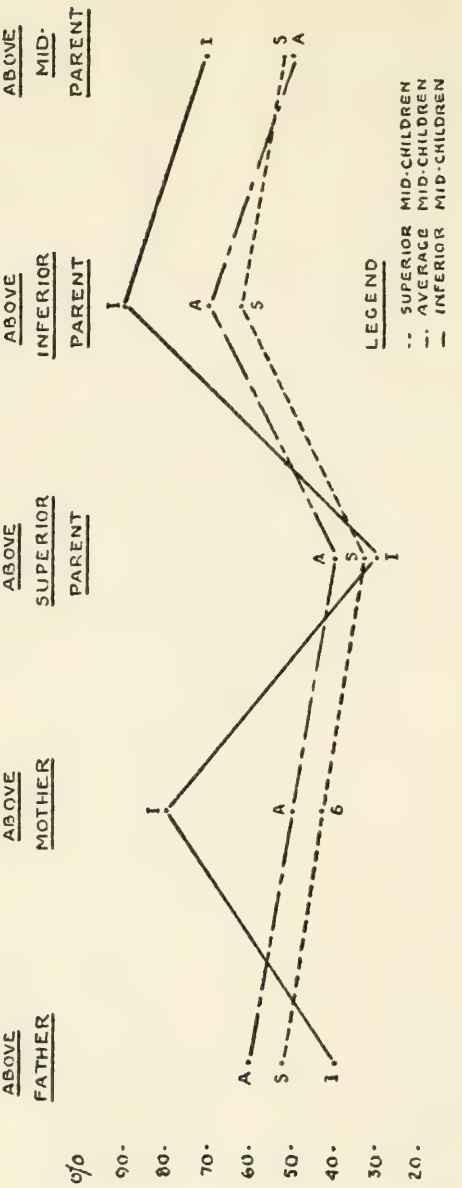
DISTRIBUTION OF SUPERIOR, AVERAGE AND INFERIOR CHILDREN ABOVE PARENTS

PLATE VI



DISTRIBUTION OF PARENTS AND MID-CHILDREN ABOUT MID-PARENT

PLATE VII.



DISTRIBUTION OF SUPERIOR, AVERAGE AND INFERIOR MID-CHILDREN ABOVE PARENTS

1. *Parent Correlation*

In obtaining the correlation between father and mother, the elimination of parents having physical conditions which might affect mental ability or the exercise of it, and language difficulties naturally resulted in a more reliable coefficient of correlation than would be obtained from a random selection of parents. The correlation between father and mother in this selected group was found to be .741 ± .042. The inference is, on the whole, that an individual tends to marry another of similar ability.

2. *Child Correlations*

Previous studies of mental traits of siblings show correlations ranging from .27 to .68. The most frequently quoted finding is that of Pearson. He obtained a correlation of .50 between brothers and sisters in both mental and physical traits. In discussing this finding Thorndike says that Pearson emphasizes the fact that "the correlations for mental and physical traits are the same, but it seems incredible that environment should not have *some* influence on the mental resemblances. Where the physical resemblance is really .50, we should expect .60 from the mental traits."[27] Thorndike obtained a correlation of .60, corrected for attenuation, between 489 pairs of high school siblings tested on the I.E.R. tests. He ascribes some of this resemblance to environment, although the amount cannot, of course, be known.

In the present study the correlation between 63 pairs of brothers and sisters was .670 ± .047, and between the mid-brothers and mid-sisters, .736 ± .045.

When the siblings were paired in serial order—the first child with the second, the third with the fourth, etc., omitting the odd child where occurring—the correlation between pairs was .595 ± .041. This is in agreement with Thorndike's results for high school siblings.

When the siblings were correlated individually, only those families were used in which the first four children were available. The correlations between the individual children were found to be above Pearson's .50 in every case except one—that between the first and second child. The exclusion of one isolated case where the first and second child differed widely in I.Q. (131, 69) raised the first-

[27] Eugenical News, Feb. 1927, Vol. 12, No. 2. Report on paper by Dr. Thorndike on "The Measurement of Resemblance between Brothers and Sisters."

second child correlation from .423 ± .095 to .638 ± .070. There seemed to be no reason for excluding this family however, since, so far as could be learned, the health history was satisfactory.

The correlation between the first and third child, .728 ± .054, was appreciably higher than those between the other children with the exception of that between the second and fourth child which was .615 ± .072.

Table XXXVII shows the correlations between the children. The mid-brother–mid-sister correlation was the highest, of course, followed closely by the first-third child correlation. Since the brother-sister correlation was below that of the first-third child, and since the sexes were equally represented in the first and third groups, there appeared to be some relation, in this case, between order of birth and child resemblance.

TABLE XXXVII

CHILD CORRELATIONS

	Second Child	*Third Child*	*Fourth Child*
First Child	.423 ± .095	.728 ± .054	.545 ± .081
Second Child		.519 ± .084	.615 ± .072
Third Child			.577 ± .078
Brother–Sister			.670 ± .047
Mid-Brother–Mid-Sister			.736 ± .045
First-Second Child–Third-Fourth Child, etc.			.595 ± .041

3. *Parent-Child Correlations*

(a) Parents–Single Children.—As the number of families with five or more children was small, correlations were obtained for the parents and the first four children only. These correlations are given in Table XXXVIII.

When a single parent and a single child were compared, the correlations ranged from .36 to .70, averaging .58. The correlation of the oldest child with the mother came out notably high, while that of the second child with the father was notably low. In general the correlations of a single child with the mother were higher than with the father, a tendency which may be due to the children's more intimate contact with the mother.

The low correlation of the second child with the superior parent is, to a great extent, the same fact as the low correlation of this child with the father, since the majority of the superior parents were fathers.

The low correlation of the second child with the superior parent is, to a great extent, the same fact as the low correlation of this child with the father, since the majority of the superior parents were fathers.

The mid-parent–single child correlations are higher than those with the separate parents, as will be discussed later. The first child shows an especially high correlation with the mid-parent, in accordance with his relatively high correlations with the separate parents, while the second child's correlations run especially low. The first child in these 51 families was, therefore, most like the parents, while the second child was least like them. These differences can, of course, be regarded only as suggestive. They are shown graphically in Plate VIII.

TABLE XXXVIII

PARENT–SINGLE CHILD CORRELATIONS

Child	*Father*	*Mother*	*Superior*	*Inferior*	*Mid-Parent*
1	.591 ± .069	.688 ± .055	.675 ± .057	.665 ± .059	.731 ± .049*
2	.400 ± .086	.571 ± .069	.361 ± .089	.557 ± .071	.545 ± .072
3	.576 ± .068	.629 ± .061	.561 ± .070	.698 ± .052	.656 ± .058
4	.567 ± .074	.556 ± .076	.639 ± .065	.549 ± .076	.629 ± .066

* P.E.

Note: The apparent discrepancies in the P.E.'s are due to the difference in the number of cases of first, second, third and fourth children (41, 43, 44, 38, respectively).

(b) Parents–Mid-Children.—The mid-child is the average of from four to ten children in a family. Approximately three-fifths of the families had only four children. The mid-son group included eleven families with one son, fourteen with two, ten with three, nine with four and four with five or more. The mid-daughter group included twelve families with one daughter, ten with two, fifteen with three, nine with four and three with five or more. The correlations are given in Table XXXIX.

The mid-child correlates more highly with the parents than does the single child, the coefficients ranging from .63 to .78, with an average of .71.

The mid-child is the best representative value for a fraternity. Each child can be regarded as a sample of the product of a given pair of parents, two children as a more adequate sample, and the whole fraternity as the most adequate sample available. If we wish to know how far the child-product of two parents resembles those

parents, the mid-child is the truest representative of the product and the mid-parent is the truest representative of the parental characteristic. The correlation between mid-parent and mid-child is, therefore, the most adequate empirical measure of the resemblance. This correlation, in the present series of data, was found to be .802. This comparatively high value, then, is put forward as a measure of the tendency of two parents to reproduce their characteristics in their offspring. They "reproduce" their characteristics, no doubt, partly by way of heredity and partly by training and other post-natal influences, as well.

The fact that the above measure of resemblance between parents and children is so much higher than the correlation of .50 to .60 found between a single parent and a single child does not imply any contradiction between the two values. If a single child is regarded as a sample of the child-product of its parents, the correlation between single child and single parent, or between single child and mid-parent, is attenuated by the chance variability between children of the same parents. The correlation between mid-child and mid-parent is, in a way, though not completely, corrected for this attenuation. The tendency for parents to reproduce their characteristics in their off-spring is probably somewhat greater than that indicated by the above correlation of .80.

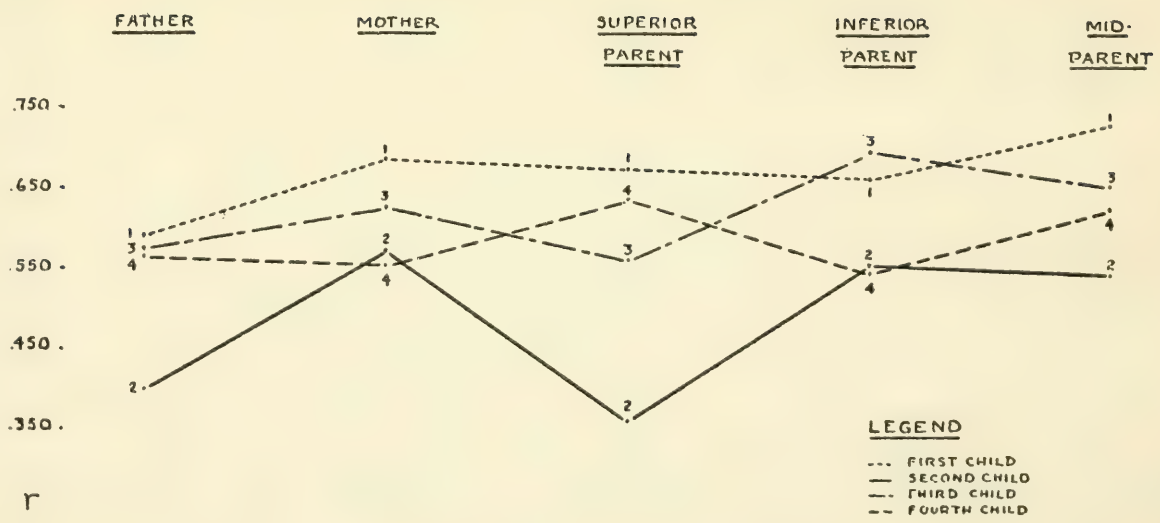
Comparison of the mid-son and the mid-daughter correlations with the parents indicates that the daughters resemble their parents somewhat more than do the sons. This difference, for what it is worth, is shown in Plate IX.

TABLE XXXIX
PARENT–MID-CHILD CORRELATIONS

Mid-Children	*Father*	*Mother*	*Superior*	*Inferior*	*Mid-Parent*
Mid-Son	.628±.050	.700±.049	.674±.053	.707±.049	.733±.045
Mid-Daughter	.692±.050	.697±.049	.718±.047	.720±.046	.763±.040
Mid-Child	.694±.049	.775±.038	.744±.042	.780±.037	.802±.033

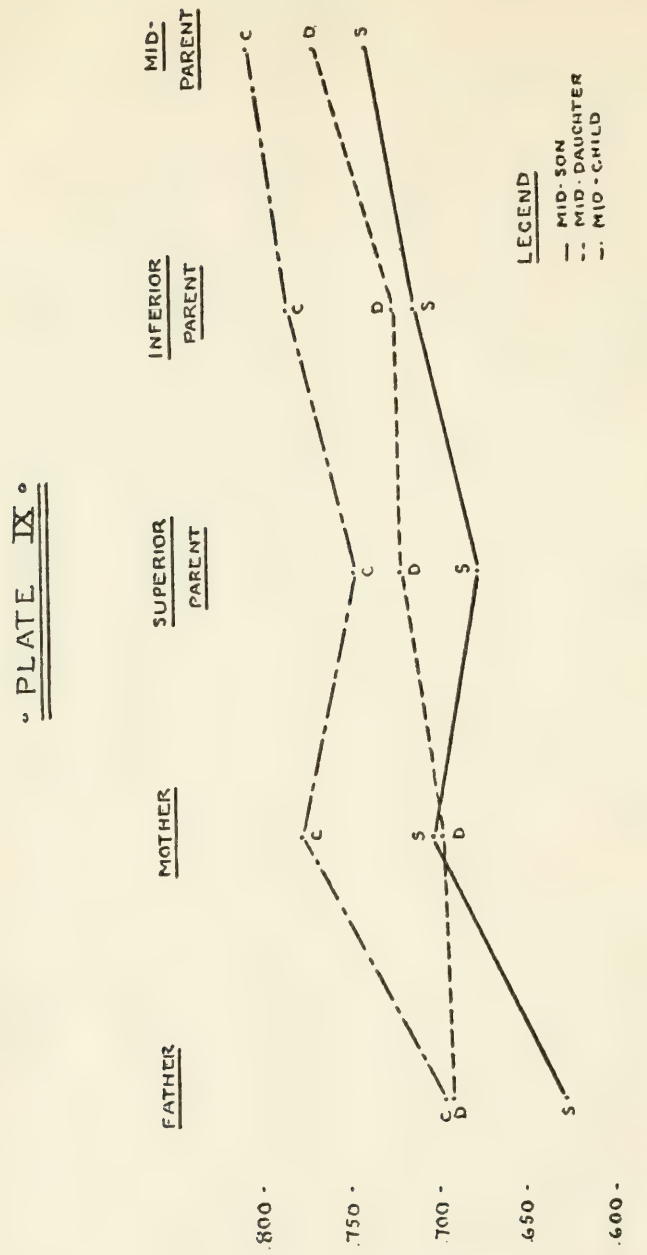
(c) Comparison of Two Studies.—In comparing the results obtained in this study with those of other investigators, it must be remembered that correlations based upon average ratings would be higher than those based upon the rating of a single child with a parent. They would also be higher than those obtained from average ratings of offspring from smaller sized and unselected families.

PLATE VIII



PARENT - SINGLE CHILD CORRELATIONS

PLATE IX.



PARENT - MID CHILD CORRELATIONS

A comparison of the parent-child resemblances obtained in this study with those found by Jones (Table XL) showed them to be similar, although in the present case the parent mid-child correlations were from 8 to 12 points higher. This difference may be accounted for by the difference in selection.

In both groups the correlation of the mother and the mid-child was slightly higher than that of the father and the mid-child, but insignificantly so. Neither group showed any significant difference between the influence of the superior and the inferior parent on the intelligence of the offspring. The present group showed a tendency for the daughters to resemble the parents slightly more than did the sons, whereas the sons in the Jones group were more like the parents. In neither case were the differences reliable. Association probably explains it in both cases. In rural groups the sons are more apt to be kept at home as soon as they are old enough to be of use, while the daughters are more likely to continue their education to fit themselves for other vocations.

TABLE XL

COMPARISON OF TWO STUDIES OF PARENT-CHILD RESEMBLANCE IN I.Q.

Group	*Jones*	*Outhit*	*Diff.*
Father, Mid-Son	.580 ± .048	.628 ± .050	.048
Father, Mid-Daughter	.492 ± .054	.692 ± .050	.200
Father, Mid-Child	.592 ± .043	.694 ± .049	.102
Mother, Mid-Son	.608 ± .048	.700 ± .049	.092
Mother, Mid-Daughter	.591 ± .044	.697 ± .049	.106
Mother, Mid-Child	.653 ± .038	.775 ± .038	.122
Superior Parent, Mid-Son	.624 ± .044	.674 ± .053	.050
Superior Parent, Mid-Daughter	.578 ± .048	.718 ± .047	.140
Superior Parent, Mid-Child	.662 ± .037	.744 ± .042	.082
Inferior Parent, Mid-Son	.656 ± .040	.707 ± .049	.051
Inferior Parent, Mid-Daughter	.579 ± .048	.720 ± .046	.141
Inferior Parent, Mid-Child	.660 ± .037	.780 ± .037	.120
Mid-Parent, Mid-Son	.648 ± .042	.733 ± .045	.085
Mid-Parent, Mid-Daughter	.610 ± .045	.763 ± .040	.153
Mid-Parent, Mid-Child	.693 ± .034	.802 ± .033	.102

(c) *Regression*

Bearing in mind Galton's statement that it is only when parents are mediocre that their sons resemble them, it should follow that when parents are not mediocre their sons do not resemble them. How often and how widely the children varied from their parents

in the present study is shown in Plate X, where the expected I.Q. of the mid-child, based on the mid-parent mid-child correlation of .802, was contrasted with the actual mid-child I.Q. obtained.

The expected I.Q. of the mid-child was derived as follows. From the mid-parent mid-child correlation of .802 ± .033, the regression equations in score form (I.Q. points) of mid-parent and mid-child, where X equals the mid-child score and Y equals the mid-parent score, are: $X = .59\ Y + 44.43$; $Y = 1.1\ X + 11.18$. The standard error of estimate of X is 8.12, and that of Y is 11.14. If the I.Q. of the mid-parent be known and substituted for Y in the formula for X, the most probable I.Q. of the mid-child can be obtained. For example, when the mid-parent has an I.Q. of 100, the most probable I.Q. of the mid-child will be 103.43, with a standard error of estimate of 8.12. That is, the chances are 68 in 100 that the actual I.Q. of the mid-child will fall within 95.3 and 110.0.

The prediction can be made only for the mid-child of families selected on the same basis as the families on which the regression equation was established. Furthermore, it must be kept in mind that for a correlation of .802, the coefficient of alienation is .6, and that the standard error of estimate for both parents and children is large. Too much reliance cannot be placed, therefore, on the predictive value of this regression equation.

Table XLI gives the I.Q. of the mid-parent at step intervals of ten, and the theoretical mid-child I.Q. for these intervals. From the equation $Y = 1.1\ X + 11.8$, a similar table could be constructed for the parents.

An examination of Plate X shows that in 37 of the 51 families the mid-child regressed toward the mean of the general population. In almost half of these instances the amount of regression was some-

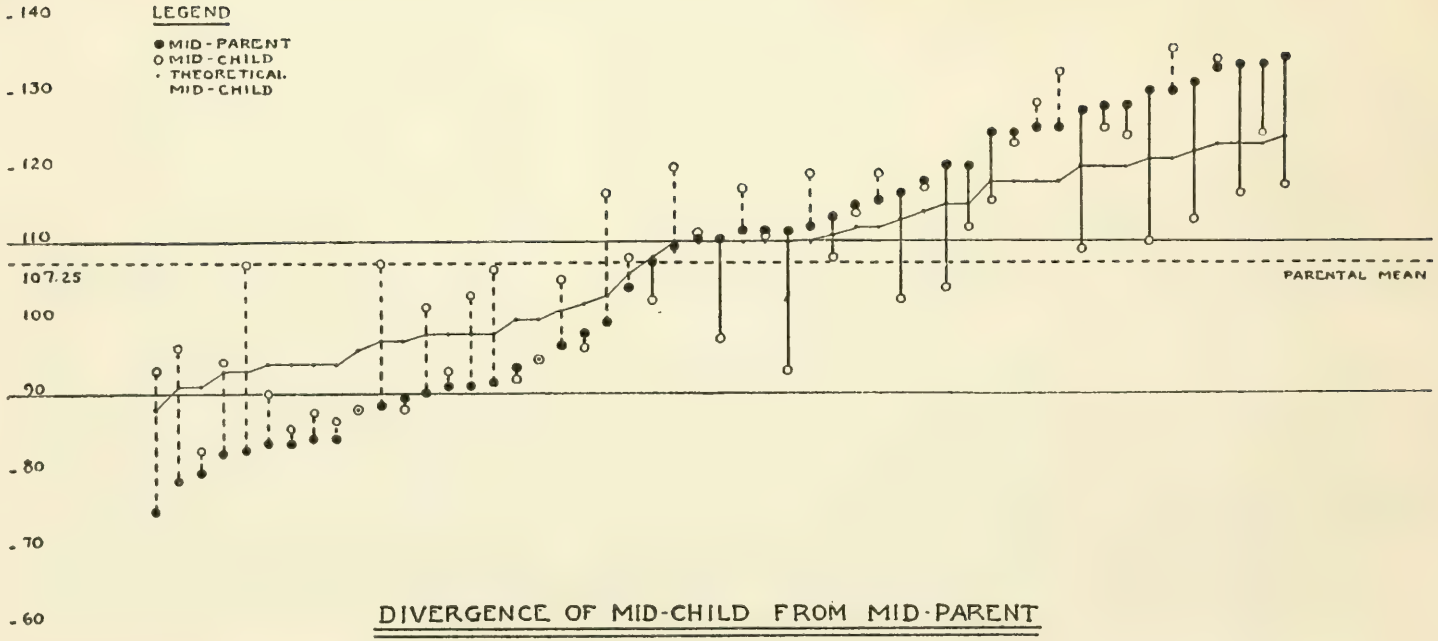
TABLE XLI

THEORETICAL I.Q. OF MID-CHILD ACCORDING TO I.Q. OF MID-PARENT

I.Q. of Mid-Parent	*Theoretical I.Q. of Mid-Child*	*I.Q. of Mid-Parent*	*Theoretical I.Q. of Mid-Child*
60	79.83*	100	103.43
70	85.73	110	108.33
80	91.63	120	115.23
90	97.63	130	121.13

* S.D. 812.

PLATE X



DIVERGENCE OF MID-CHILD FROM MID-PARENT

what greater than would be expected. In the 15 families in which the mid-child did not regress toward the average, the amount of digression, except in two instances, was so small as to be insignificant. We may conclude then, that, on the whole, the offspring tend to regress toward the mean of the general population.

(d) *Other Considerations*

1. *Parent Difference and I.Q. of Offspring*

The question arose as to whether the offspring of parents closely alike in mental ability were less variable than those of parents differing widely in ability.

To answer this, only the test scores of the four oldest children were used in order that the families might be comparable in size. The variability was determined by using the formula $\frac{(a+b)-(c+d)}{2}$, where a = child rating highest in intelligence, b = child rating second highest, c = child rating third, and d = child rating fourth. In each family the sum of the I.Q.'s of the two children rating lower was thus subtracted from the pair rating higher and the difference divided by two. The result, correlated with the difference between the I.Q.'s of the father and the mother (Pearson Product-Moment), gave a correlation of $-.086$.

The conclusion is that, in a similar sample, the variability of the offspring cannot be predicted from the divergence in ability of the parents.

2. *Parent Education and I.Q. of Offspring*

The use of the Army Alpha test with the adult group automatically excluded completely illiterate persons and, generally speaking, those who had not gone beyond the fourth grade, for it was assumed that fifth grade schooling or its equivalent would be necessary if the Alpha scores were to give an approximately accurate rating of an individual. However, 2 parents with no formal education beyond the third grade and 5 who had not gone beyond the fourth grade were included in the test as they showed more facility in reading than did many who claimed to have reached higher grades. Furthermore, their conversation and range of interests indicated the probability of sufficient self-education to make them eligible. Their test results confirmed this impression, as they were equivalent to, or better than some individuals who had gone through five or more school grades.

Of the 7 parents (4 fathers, 3 mothers) who gave no information as to their schooling, 3 were known to have had some secondary education, while 6 held responsible business positions and made scores higher than the median for the whole parent group.

Of those who answered the question on schooling, 47 parents (23 fathers, 20 mothers) had only primary school education. Thirty-four parents (13 fathers, 21 mothers) had some high school education and 14 parents (11 fathers, 3 mothers) completed college, 2 of them going on to post-graduate work.

TABLE XLII

GRADE AT WHICH FORMAL EDUCATION OF PARENTS CEASED

Grade	*Fathers*	*Mothers*	*Total**
Grade III	1	1	2
Grade IV	0	5	5
Grade V	5	4	9
Grade VI	3	3	6
Grade VII	6	4	10
Grade VIII	8	7	15
1st Year High School	5	1	6
2nd Year High School	6	6	12
3rd Year High School	1	6	7
4th Year High School	1	8	9
4th Year College	10	2	12
Post-Graduate	1	1	2

* 7 not obtained.

To answer the question as to whether or not there was a closer parent-child resemblance in families where the parents had secondary or college education than where they had only primary education, the families were divided as follows: (1) those in which both parents had only primary education, (2) those in which one parent had primary and one secondary, and (3) those in which both parents had secondary. The divergence of the mid-child I.Q. from the mid-parent I.Q. was found for each family.

Table XLIII shows the average I.Q. divergence of the mid-child from the mid-parent to be greatest in the group where both parents had only primary education. It is probable that some of these parents were forced to leave school before reaching the educational limit set by their native ability, and that the rating obtained by them is farther from their true rating than that obtained by the parents whose pencil and paper habits were more perfectly established and more continuously exercised. The median Alpha score for fathers with only primary school education was 57 and for

mothers, 45. The median Alpha score for fathers with secondary school education or better was 141 and for mothers, 148. The median score for all fathers was 97 and for all mothers, 92.

TABLE XLIII
DIVERGENCE OF MID-CHILD FROM MID-PARENT ACCORDING TO I.Q.

Educational Group	*No. of Families*	*Ave. I.Q. Divergence*	*Range of Divergence*	*Diff.*
Both Parents Primary	18	+6.28	6–28	22
One Parent Primary One Parent Secondary	9	+2.67	5–26	21
Both Parents Secondary	20	+3.02	1–15	14

3. *Parent Age and I.Q. of Offspring*

Much speculation has been indulged in as to the effect of the age of the parents upon the physical and mental qualities of their offspring. In spite of numerous examples to the contrary, many people still cling to the idea that children born to parents beyond the physical prime of life are not so well equipped as those born to younger parents. Their opinion seems to be that a person is at his best physically and, one may infer, mentally, around 25 years of age, and that the optimum period for the individual is the optimum period for reproduction.

Evidence that in certain mental abilities an individual is at his best in the early twenties is afforded in a recent study by Willoughby.[28] In tests of arithmetical reasoning, vocabulary, opposites and nature-science information, he found that maximum ability was reached in the neighborhood of 25 years. In form combination, history-literature information and substitution, the maximum was reached around 20 years. In number completion and analogies, the maximum was reached before 20. His curves for the mean and the standard deviation show "a somewhat sharp rise and a long, gradual decline; and they are proportional to each other." Of these curves, that for arithmetical reasoning alone showed no appreciable decline up to the age of 60. Willoughby suggests "differential selection or survival" and "possibly the remoteness of the older individual's education and its more meager absolute amount" as causes contributing to the long decline of the curves.

In the present study the scores of the younger and older parents were compared to see if there was a difference in mental ability.

[28] Willoughby, R. R., *Family Similarities in Mental Test Abilities.* Genetic Psy. Mono. Vol. II, No. 4, 1925.

The median Alpha score for 35 younger parents (30–39 years) was 91. The median Alpha score for 56 older parents (40–49 years) was 95. All that can be said is that as a group the older parents were not inferior to the younger. What the older group would have scored at the age of the younger cannot, of course, be known.

The relation between age of mother and I.Q. of offspring next was considered. Twenty-two of the mothers studied had children born to them both before and after they had reached the age of 25. Of the children born before the mother was 25, the average deviation from the mother's I.Q. was +5.29. Of the children born after the mother was 25, the average deviation was + 6.47. As 20 of the 22 mothers were under 35 at the time of the birth of the last child tested, any decline in power to use their ability would be less marked than it would among older parents. Considering the size of the group and the number of factors other than chronological age which are involved, no conclusion can be drawn as to the effect of the age of the mother upon the intelligence of the offspring.

4. *Order of Birth and I.Q. of Offspring*

The question of the influence of order of birth on intelligence is closely connected with the question of age of parents and its effect on the intelligence of the offspring. It is a commonplace that parental interest is apt to center on the activities and accomplishments of the oldest or youngest child, and it is for these children that the admiration of outsiders is most often claimed by the parents. It would seem that this parental interest is not based solely upon the fact that the admired child is the first or last born.

Havelock Ellis, from his study of British genius, concludes that "it would appear that there is a special liability for the eldest and youngest children to be born with intellectual aptitudes, the liability being greater in the case of the eldest than of the youngest."[29] Yoder already had reached this conclusion from his study of fifty eminent men of different nationalities. Terman, in his "Genetic Studies of Genius," states that his "data on order of birth, as far as they may be considered valid, are in striking agreement with Cattell's figures in showing a preponderance of first-born gifted in families of two or more."[30]

An examination made by Arthur of 70 pairs of siblings of American birth and parentage showed a slight difference in favor

[29] Ellis, Havelock, *A Study of British Genius.* London: Constable, 1927.
[30] Terman, L. M., *et al., Genetic Studies of Genius.* Vol. I, 1925.

of the younger.[31] The children were tested between the ages of 5 and 7 years, and again after they had been in school for about the same length of time. The average I.Q. of the elder was 105.9 with an S.D. of 11.23; that of the younger was 106.9 with an S.D. of 10.67. This difference is not significant. There was no indication that the sibling pairs occupied the same position with respect to order of birth.

In the present study there were 34 families in which the first four children in order of birth were tested. The average I.Q. of the first child was 114.1 with an S.D. of 17.18; that of the second child was 107.7 with an S.D. of 17.04; that of the third child was 107.5 with an S.D. of 15.8, while that of the fourth child was 107.4 with an S.D. of 15.65. This would indicate that there is a tendency for the first-born to be slightly more intelligent than the second, third and fourth-born.

5. *Size of Family and I.Q. of Offspring*

Sutherland and Thomson, in a study of 1,084 unselected school children of $10\frac{1}{2}$–$11\frac{1}{2}$ years, obtained a correlation of $-.32$ between intelligence and position in the family. As their families varied in size, they interpreted their results as "largely due, not to position in the family, but to size of family: at least the two are here intermingled, for the first-born included all the only children, while the seventh-born necessarily belong to a large family." They conclude that "there is no clear proof of any correlation between intelligence and position, but there is a negative correlation of .20 between intelligence and size of family."[32]

Chapman and Wiggins, in a study of families with American-born parents, found a correlation of $-.22 \pm .04$ between size of family and intelligence, but concluded that their results showed that order of birth had no appreciable effect.[33] Pearson and Moul, from their study of 1,200 school children of 7 to 15 years, found no significant correlation between position in family or size of family and I.Q.

In the present study the correlation between size of family and intelligence was $-.045$. This is in accordance with the results obtained by the above investigators working with large groups.

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[31] Arthur, Grace, *Relation of I.Q. to Position in Family.* Jour. Educ. Psy., Vol. XVII, No. 8, 1926, pp. 541–55.

[32] Sutherland, H. E. G., and Thomson, G. H., *The Correlation between Intelligence and Size of Family.* Brit. Jour. Psy., Vol. 17, 1926.

[33] Chapman, D. C., and Wiggins, D. M., *Relation of Family Size to Intelligence of Offspring and Socio-Economic Status of Family.* Ped. Sem. and Jour. Psy., Vol. 32, 1925, pp. 414–21.

IV. SUMMARY AND CONCLUSIONS

1. The distinctive character of this study is that it is based upon intelligence tests of complete families, each consisting of both father and mother and at least four children. Thus it is possible to secure a reliable correlation between the two generations, to see how the children are distributed with reference to the mean of their respective parents, to see how the variation among the children of a fraternity is related to the amount of difference between the parents, to examine whether the children resemble more closely the father or the mother, and whether sex is a factor influencing the relationship. It is also possible to see whether there is a tendency for the children to regress toward the mean of the general population.

2. The principal difficulty encountered—aside from the practical difficulty of obtaining tests of complete families—resulted from the necessity of using different tests for adults and for children under twelve, the tests actually used being the Army Alpha and the Stanford-Binet. The raw scores were reduced to terms of I.Q. to make them comparable, but this reduction raised the question of the mental growth limit to be applied to individuals above fourteen years of age. On the assumption that the average for the whole array of parents should equal that of their children, a growth limit was worked out of 14 years and 10 months. On the basis of the occupational distribution of the parents, their average I.Q. should be 106, which would be the case if the growth limit were taken at 15 years even. The correlations were calculated also for growth limits of 14 years and of 16 years and 5 months, and the conclusions drawn from the correlations, and stated below, were found to be unaffected by these differences in the growth limit selected.

3. The correlation between a single parent and a single child was found to range from $.400 \pm .086$ to $.688 \pm .055$, according to which parent and which child were compared. In general, the correlation of single parent and single child is only slightly higher than the figure of .50 usually accepted. The somewhat higher correlation here found may be attributed to the exclusion of all families in which there was evidence of such a disease of epilepsy, which might lower the intelligence of some individuals in the family and so lower the correlation.

4. When, however, the single child was compared with the mid-parent, the correlations rose, the range being from $.545 \pm .072$ to

.731 ± .049. And when the mid-child was correlated with the mid-parent, the correlation rose to .802 ± .033. This relatively high correlation is interpreted as representing approximately the true relationship between the two generations. Either parent can be thought of as an incomplete sample of the older generation, subject to chance error that would attenuate the correlation; and, in the same way, any one child can be regarded as an imperfect sample of the younger generation, subject likewise to chance error attenuating the correlation. The correlation between mid-parent and mid-child, accordingly, is partially corrected for these attenuations, and may be regarded as approximating, though probably somewhat below, the true correlation between two successive generations.

5. The correlation of brother-sister pairs was .670 ± .047; of mid-brother mid-sister .736 ± .045, while for siblings paired according to serial position the correlation of .595 ± .041 corresponded closely with Thorndike's correlation of .60 for high school siblings.

6. The correlation of individual siblings taken in order ranged from .423 ± .095 to .728 ± .054 according to which children were compared, the extreme correlations being the first-second and first-third child respectively.

7. When the offspring were divided according to sex and compared with the father and with the mother, the correlations ranged from .628 ± .050 to .700 ± .049. When the parents were divided according to ability and compared with the offspring of each sex, the same slight differences were found, the correlations in this instance ranging from .674 ± .053 to .718 ± .047.

8. The correlation between the variability of the offspring and the difference in ability of the parents was .086.

9. The correlation between the husband and wife was .741 ± .042, leading to the conclusion that an individual tends to marry one of similar ability.

10. The tendency is for the offspring to regress toward the mean of the general population.

We may conclude then that the true relationship in mental ability of two successive generations of a family is approximately .80; that the intelligence of the offspring can be predicted as well from one parent as from the other whether the parent be selected on the basis of sex or ability; that the variability of a fraternity cannot be predicted from the divergence in ability of the parents; and that the offspring tend to regress toward the mean of the general population.

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